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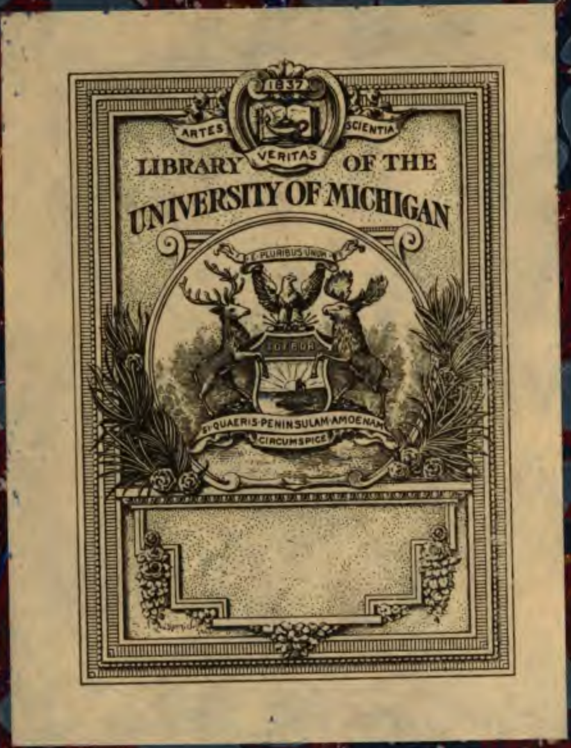

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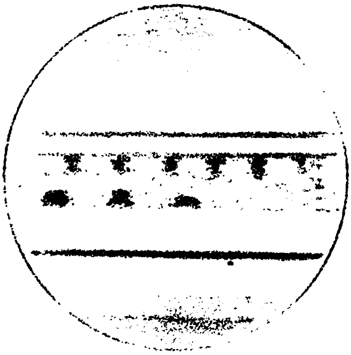

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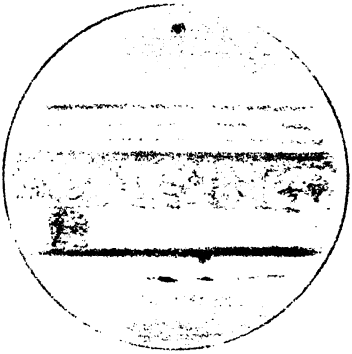

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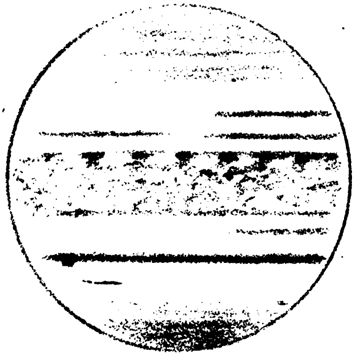

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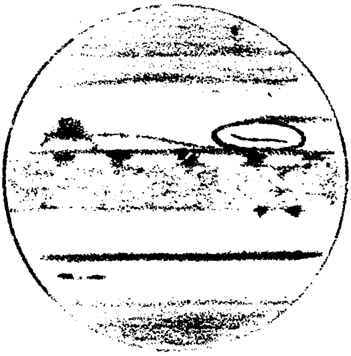

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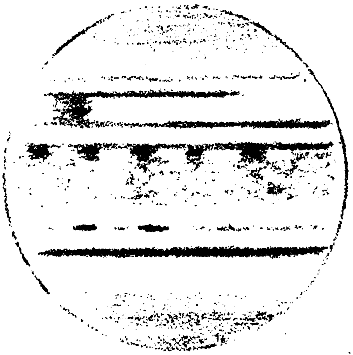

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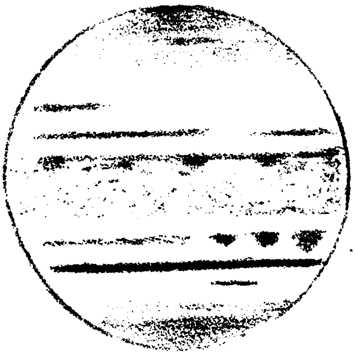

Mr. E. Crossley's Observatory, Park Road, Halifax.

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THE

ASTRONOMICAL REGISTER:

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The Astronomical Register.

No. 109. JANUARY. 1872.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Second Meeting, December 8th, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last meeting were read and confirmed. Thirty-four presents were announced, and the thanks of the Society voted to the respective donors.

E. G. Monk, Esq., and
Duncan Darroch, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

Observations of Tempel's Comet: by Mr. Hind.

Elements and Ephemeris of the same: by the same.

Ephemeris of Tuttle's Comet for the Southern Hemisphere: by the same.

Occultation of Vesta by the Moon: by the same.

This will occur on December 30, the immersion at 10h. 44m., G. M. T., and the emersion at 11h. 52m. G. M. T. There is no record of any similar occurrence before.

Mr. Dunkin said that it would be useless to look for the immersion which happened at the bright limb of the moon, as the light there was sufficient to obscure 6th magnitude stars before the occultation, and Vesta only appeared of the 7th magnitude, but with fair telescopes the reappearance at the dark limb might be looked for.

On the Floor of Plato: by Mr. Birt.

The author had suspected that the sun produced a darkening effect on the floor of Plato, and upon examining 133 observations by different observers he found this idea confirmed. He had projected the result graphically into a light curve, accompanied by one of the sun's altitude, which showed that after sunrise the tint darkened to the meridian elevation, and then lightened again.

Capt. Noble wished to know how the tints were compared?

Mr. Birt: By estimating them as light or dark, and as compared with the adjoining Mare Imbrium.

Capt. Noble: But that surface would be similarly affected. You want something external. Was your *Homochromoscope* used?

Mr. Birt: No. The tints were derived from the estimations given by the different observers.

The President: Do you not want a standard of comparison in order to project your curve with accuracy?

Mr. Birt: It would be desirable, but the investigation has not proceeded far enough at present. It is quite clear there is a difference according to the solar elevation. I have noticed this for 11 years, but never had materials for a curve before.

Capt. Noble suggested the employment of a wedge of coloured glass with a graduated edge to measure the tints.

Mr. Birt: Nothing could be better, but it is difficult to get observers to use it.

On the Spectrum of Hydrogen at low Pressures: by Mr. Seabroke.

The author during the summer has been comparing the lines of Hydrogen and the Sun, to see if there were any more lines due to that gas in the *chromosphere* than those already known. His experiments were made at the Rugby Observatory. The hydrogen tube was connected with a Sprengel pump, and the pressure reduced to 3 or 4 m m. of mercury; a battery and coil being used to pass the sparks through the gas. The room was darkened, and sunlight obtained when required by reflection from a heliostat in the roof. The light of the spark was concentrated by a lens on the slit of the spectroscope (which consisted of 4 prisms of

60^c) and passed twice through the train. Twenty-one lines were examined, but only the C and F hydrogen lines were found to coincide with any in the chromosphere. In making this statement a line near *g* and the line *h* which are known to be due to hydrogen are not included.

Occultation of ε Capricorni by the Moon, on Nov. 18, 1871: by Capt. Noble.

The star disappeared instantaneously at the dark limb of the moon at 22h. 52m. 31·3s. L. S. T.=7h. 3m. 0·7s. L. M. T., and reappeared pretty sharply at the bright limb at 23h. 39m. 8s. L. S. T.=7h. 49m. 38·9s. L. M. T. The star being low there was a good deal of undulation.

Eclipse of Jupiter's Third Satellite, on Dec. 4, 1871: by Capt. Noble.

It is impossible to say exactly when the light was first diminished, as it took several minutes to fade out. The last glimpse was at 1·18·7. Capt. Noble thinks it should be settled what *is* the eclipse, whether when the fading begins, when the satellite is dichotomized, or when it finally disappears. The latter will not do, as it would be seen so much longer in large telescopes than in small ones. He also again adverted to the inaccuracy of the tables.

The President: The *Nautical Almanack* tables of Jupiter's phenomena were not intended for large telescopes.

Capt Noble: That is true, but it is not the question. I want to know why Damoiseau's Tables, which are admittedly incorrect, are still used in the computations for the *Nautical Almanack.*

Mr. Dunkin: The Society ought to be very much obliged to Capt. Noble for calling attention to the errors of Damoiseau's Tables. It is easy to say compute new ones, but not so easy to do. With respect to the time of disappearance I have probably seen as many of these eclipses as most people, and I take the disappearance to be when I cannot see the satellite any longer, and the reappearance to be when the first faint light appears which gradually grows stronger. The tables were certainly intended to be used with telescopes of small aperture. The *Nautical Almanack* is a wonderful work, and the errors are very small indeed in most cases. Even in using these eclipses for the determination of longitude, the present tables would give it within a quarter of a degree as well as the best tables that ever could be made. The errors with the 1st and 2nd satellites which move slowly are very small, with the 3rd they are greater, and the 4th has been even twenty minutes out, but eclipses of this satellite are very scarce indeed. We saw one lately, and I was surprised to find the error was only two minutes.

Capt. Noble: That was only a fluke. When we compared the *Nautical Almanack* with the Greenwich Observations here on a former occasion, we found an error of 19s. with the 1st satellite. Now these eclipses are very sharply seen, and I contend that they could be used for getting the longitude with telescopes of given dimensions, and errors of 19 seconds ought not to occur.

Mr. Dunkin: The observations at present are made with apertures from 3 to 13 inches. With the equatorial, the satellite is seen later, and again earlier than with anything else.

Note on the November Meteors: by Capt. Noble.

During his watch from 12h. to 1h. 15m., on November 13, the author failed to see a single meteor.

Mr. Glaisher said that every minute of the nights of November 13 and 14 was watched by the Greenwich observers, and they only saw 30 meteors in the whole time. Captain Noble's observation was important as showing that we were now well out of the stream of meteors, and not likely to see many for nearly 30 years. As to Jupiter's satellites, the *Nautical Almanack* represented the tables of the time, and although materials for improving them existed, it could not be said it was Mr. Hind's duty to calculate new ones. It was much to be regretted we generally left foreigners to discuss the results of our excellent observations.

Mr. Ranyard suggested that to rely on such observations, we wanted not only a fixed aperture, but a fixed amount of cloud, and a fixed altitude of Jupiter.

The President: It would require the mean of observations by a number of observers, through a series of phenomena, before we could say the *Nautical Almanack* failed to do what it professed.

Capt. Noble: I am not saying the almanack is not well computed; but why are not the tables corrected? If not Mr. Hind's business, I should like to know whose it is?

Professor Cayley suggested that we wanted another thing. The book represented existing tables, and observations should be obtained for comparison, before attempting to alter it.

Capt. Noble: We want some German, Swede, or other foreigner to make tables which no Englishman can or will do.

Mr. Ranyard: Even with a standard telescope, differences of altitude or other circumstances would make a difference of 1-8th of a degree of longitude.

Mr. Dunkin said that to make the *Nautical Almanack* a perfect production, the tables of all the bodies must be recomputed. Even the moon sometimes differed from its computed place a second, and it might be different another time, so that a table of corrections had to be used. He thought that the Germans would soon produce new tables of Jupiter, Saturn, and Uranus.

On the Geodesic lines in an Ellipsoid: by Professor Cayley.

The author explained this paper orally, illustrating his remarks by a diagram.

Rev. J. C. Jackson read a letter from Mr. Gledhill, accompanying a drawing of *Jupiter* which was exhibited to the meeting. In 1869, Mr. Gledhill observed a remarkable elliptical formation on the planet which had now reappeared. The drawing was made on December 1, 1871, about 11h. 30m., G. M. T., with an achromatic telescope of 9¼ inches aperture and power of 240. The ellipse was situated just to the south of Mr. Gledhill's band 4 and was 15″ in length. Its shape was regular, and it was preceded by a large whitish spot on the same parallel. It seemed the same configuration as seen before, or else one exactly like it. There appeared to be some connection between this form and the small white spots.

Capt. Noble saw the small white spot last month with his telescope of 4-2 inches aperture.

Mr. Ranyard said that Mr. Gledhill had sent him a copy of the drawing in which was a curious spot like a pipe. This also had been seen before at the same time as the ellipse.

Mr. Proctor exhibited and described his original *chart of* 324,198 *stars*. He said that Mr. Brothers had given an account of its preparation and the labour involved, but that was the least part of its importance. Its real use was in assisting us to form proper views of the construction of the heavens. With regard to the objection that the constellations were not readily detected, that was entirely obviated by the accompanying small chart of the configurations.

On Mr. Abbott's imagined discovery of great changes in the Argo Nebula: by Mr. Proctor.

The author being at a loss to understand the conflicting statements on this subject, and the great discrepancies between Mr. Abbott's drawings and those of Sir J. Herschel, had examined them carefully, and believed that he had ascertained the cause to be the difference of scale between the representations. Mr. Abbott's drawings are made with a small telescope, showing a field of 1° 7′ 42″, while Sir J. Herschel's include very much less of the nebula at any one moment. The effect of this is that the *lemniscate*, which is so marked a feature in the Cape drawings, is in Mr. Abbott's only ¼ of an inch long, and is therefore hardly recognisable.

The Orion Nebula, if treated in the same way, could never be identified with the one drawn by Lord Rosse, or with other large telescopes.

On the Motion of Matter projected from the Sun, with special *reference to the outburst witnessed by Professor Young*: by Mr. Proctor.

Such outbursts as that described by Professor Young have also been seen by Secchi, and the accounts show that such statements may be relied on. Professor Young saw a prominence throw out wisps of hydrogen, rising from 100,000 miles to 200,000 miles in ten minutes. The author had calculated the velocity of the gas, which he found would be 212 miles per second if projected into a vacuum, in which it would take 25m. 56s. to travel the distance, but as it rose in ten minutes, the velocity must have been much greater, notwithstanding the retardation of the surrounding gases or vapours. He had used a graphical mode of construction, which showed how a body fell towards the sun in successive periods, and the ascent was the reverse of this. He thought the truth was that the gas ascended more than 200,000 miles, probably as much as 350,000, with a velocity of 255 miles a second. To cause hydrogen to be flung through an atmosphere, it would require a much greater velocity than that last mentioned, probably as much as 1,000 miles per second. A velocity of 379 miles a second would carry the hydrogen clear away from the sun, but we know that it is not so thrown off. May not the hydrogen carry up with it denser particles, and is it not likely or certain that these vapours, having greater density, and therefore greater velocity, would pass clear away from the sun, and might become part of the corona? The paper also referred to the probability of connection between the outbursts and any magnetic disturbances. Nothing occurred at the time at Greenwich, but at Kew five hours after there was a disturbance, although this might not have been caused by the outburst. The prominence was seen not on the photosphere, but at the edge of the sun, so that as Sir J. Herschel had remarked, in a letter written last March, it was no wonder the indications of the magnets did not occur at the same time but afterwards.

Mr. Ranyard said Professor Stokes had suggested that the polarization of the corona might be due to the precipitation of very small particles thrown up from the sun. He thought magnesium dust might be such a body, and would thus account for the radial polarization of the corona.

Mr. Glaisher said that never since the outburst seen by Mr. Carrington and Mr. Hodgson, when the magnets were affected simultaneously, had he been able to trace any connection between the magnetic disturbances and solar phenomena, although it had been diligently watched for. On the occasion of Professor Young's observation, he had supplied copies of the Greenwich magnetic curves, but nothing could be detected bearing on the supposed connection.

Capt. Noble compared the velocity of 212 *miles* a second with that of a cannon ball, viz., 1,300 *feet* in the same time, and said it was impossible to realize such a rate of motion.

Note on an especial point in the determination of the elements of the Moon's Orbit, from Meridional Observations of the Moon: by the Astronomer Royal.

Mr. Dunkin explained that this paper referred to the extreme difficulty in determining the semi-diameter of the moon. At one time of the year the observer has to take the N. limb of the moon, and during the other half-year the S. limb. The author thinks that in his former paper on the corrections of the moon's orbit, there is a small term which requires alteration, in consequence of an erroneous value having been used for the moon's semi-diameter.

Capt. Noble : It is a question of irradiation. No one ever saw the real edge of the moon's disc.

On Encke's Comet : by Mr. Hollis.

This paper was accompanied by a drawing made with an 8 inch achromatic, and power of 120, on November 12. From the sharpness of the two edges, and their brightness as compared with the interior, the author thought the comet was a hollow cone. He had tried to measure the angle included, and found it about 86°.

Dr. Huggins: The sides of the comet in this drawing are straight, but in Mr. Carpenter's and mine they are decidedly curved. I estimated the angle at something under 90°, and so far I agree with Mr. Hollis, but the two sides of the fan are not straight. On December 5, I caught glimpses of an indication of a tail. A very faint ray was projected from the apex, which is turned away from the sun.

Capt. Noble saw this on the same evening with his 4¼-inch object glass.

Mr. Dunkin : Then this prolongation is a true tail?

Capt. Noble : I also saw on Sunday night the gaseous spectrum of the comet with one of Browning's beautiful star spectroscopes.

Lunar Occultations and Eclipses of Jupiter's Satellites : by Mr. Tebbutt.

Reply to Notes and Queries, made by the Astronomer Royal, on the Observations of η *Argus* : by Mr. Abbott.

Note on the Universal Equatorial: by Mr. Browning.

Elements of Minor Planet (116): by Dr. Luther.

Formules pour le calcul des orbites des etoiles doubles : by M de Gasparis.

The meeting then adjourned.

ENCKE'S COMET.

Encke's comet has been well observed during the past month. By the kindness of the council of the Royal Astronomical Society, we are enabled to give our subscribers a beautiful picture of it as seen at the Royal Observatory at Greenwich.

Since the communication of the Astronomer Royal to the Society, of which we gave an account in last month's report, several persons have noticed that the comet was throwing out a tail from the side opposite to the fan. We refer our readers to an interesting letter from Mr. Knobel upon the subject, with a woodcut illustration, in our correspondence.

THE ECLIPSE OF THE SUN.

The following telegrams have been received:—

"From N. R. Pogson, Esq., at Avenashy, to the Astronomer Royal, Royal Observatory, Greenwich.

"Weather fine. Telescopic and camera photographs successful. Ditto polarisation. Good sketches. Many bright lines in spectrum.
Dec. 12th."

The following is a copy of a telegram received by Mr. William Huggins from Colonel Tennant, F.R.S., who is in charge of the Indian Eclipse expedition:—

Dodabetta, Ootacamund, Dec. 12th, 9.15 a.m.

Thin mist. Spectroscope satisfactory. Reversion of lines entirely confirmed. Six good photographs."

The sentence, "Reversion of lines entirely confirmed," refers to an important observation of Professor Young in Spain, last December, who saw at the moment of total observation all the dark Fraunhofer lines reversed—that is bright on a dark ground.

Upon which Dr. Huggins in the *Times* remarks:—

"Your readers will remember that you inserted a few months since an account of the preparations which were being made by this expedition.

"The sentence, 'Reversion of lines entirely confirmed,' refers to a very important observation made in Spain last December by Professor Young. This observation was described at the time by Professor Langley, one of the American party, in the following words:—

"'With the slit of his spectroscope placed longitudinally at the moment of obscuration, and for one or two seconds later, the field of the instrument was filled with bright lines. As far as could be judged during this brief interval, every non-atmospheric line of the solar spectrum showed bright, an interesting observation confirmed by Mr. Pye, a young gentleman whose voluntary aid proved of much service. From the concurrence of these independent observations, we seem to be justified in assuming the probable existence of an envelope surrounding the photosphere, and beneath the chromosphere, usually so called, whose thickness must be limited to two or three seconds of arc, and which gives a discontinuous spectrum consisting of all, or nearly all, the Fraunhofer lines showing them, that is, bright on a dark ground.'

"Professor Young adds:—

"'Secchi's continuous spectrum at the sun's limb is probably the same thing modified by atmospheric glare; anywhere but in the clear sky of Italy so much modified, indeed, as to be wholly masked.'"

Lord Lindsay, in the *Daily News*:—

"I have received the following telegram from Mr. Davis, photographer, who accompanied Mr. Lockyer's party to Ceylon:

"'Five totality negatives, Extensive corona, Persistent rifts, Slight external changes.—Mangalore Bekul.' I am, sir, your obedient servant,

Dun Echt, Aberdeen, Dec. 12. LINDSAY."

REVIEWS.

Observations on Comets from B.C. 611 *to A.D.* 1640. Extracted from the Chinese Annals by John Williams, F.S.A., Assistant Secretary of the Royal Astronomical Society. London: Printed for the Author, 1871.

This is an extraordinary book, and well worth careful reading and consideration. A discrepancy in M. E. Biot's description of the comet of October 25, 1366, caused Mr. Williams carefully to examine Biot's catalogue, which led him to conclude, that though accurate in its details, it was not sufficiently complete, and determined him to bring out a complete list of all the observations of comets recorded in the Encyclopædia of Ma Twan Lin, and in the great astronomical work called the *She Ke*. This was his main purpose, but as he went on, many interesting subjects occurred relating to Chinese astronomy, which have been incorporated into his introductory remarks.

Appended are some very valuable tables by which the Chinese time can be reduced to one reckoning, consisting of a complete set of chronological tables, giving the succession of dynasties and Emperors from the earliest period to the present time, and other tables for finding the months or moons and days.

These Tables cannot fail to be of great value to other persons as well as astronomers. At the end of the work is a Chinese celestial atlas, in which the names and positions of the asterisms and stars can readily be found.

If we may trust the antiquity of the books from which the information is gained, and Mr. Williams sees no reason to consider them less reliable than the early histories of any countries; the Chinese possessed considerable astronomical knowledge in very ancient times. "It must, however, be borne in mind that the correctness of the account given entirely depends upon the degree of credence to be placed in the *Shoo King*," (one of their five classical works, which is considered by the Chinese as their most ancient book, and which we know, as revised by Confucius about the sixth century B.C. Its antiquity is not only believed in by the Chinese themselves, but by some of the best European sinologists, and is borne out by its archaic style and construction).

Mr. Williams mentions several tests by which the accuracy of these accounts may be verified. One of the most interesting is the following:—"In the Chinese annals it is recorded, that in the reign of Chuen Kuh, the grandson of Hwang Te, in the spring of the year, on the first day of the first moon, a conjunction of the five planets occurred in the heavens in Ying Shih. Ying Shih, or as it is more usually denominated Shih, is one of the 28 stellar divisions determined by α, β, and other stars in Pegasus, extending north and south from Cygnus to Piscis Australis, and east and west 17 degrees, and comprising parts of our signs Capricornus and Aquarius. The Emperor Chuen Kuh is said to have reigned 78 years, from B.C. 2513—2436, and to have died in his 95th year, and from modern computations (I believe by M. Bailly, the French astronomer,) it has been ascertained that a conjunction of the five planets actually did take place about the time and within the limits indicated, *i. e.* on the 29th of Sep. 2449 B.C., being the 65th year of Chuen Kuh. Should this on further investigation prove correct, it will afford a strong presumption of the authenticity of the early Chinese annals, as there is no appearance of their astronomers having been at any time able to compute the places of the planets so far back, and the account is found in works published long before any intercourse with Europeans had taken place."

Assuming the authenticity of the *Shoo King*, of which Mr. Williams thinks there can be little doubt, the Chinese had made great progress in astronomy between two and three thousand years before the Christian era. They were acquainted with the true length of the year, they observed the equinoxes and solstices, they had discovered the necessity of frequent intercalations of moons or months, to keep their seasons in their true places, and were able to perform the computations necessary for the purpose, together with many other facts, proving the high degree of knowledge of astronomy to which they had attained.

The observations of comets extend from B.C. 611 to A.D. 1621. The book is one of great interest, and we may add that great credit is due to Messrs. Strangeways and Walden for the excellence of the printing.

ASTRONOMICAL PHENOMENA in 1872: by W. F. Denning. This pamphlet consists of certain tables taken from the *Nautical Almanack*, with a few introductory remarks upon the subject of astronomical observations in general. We think the compiler was ill-advised to fix the price at two shillings, as there are many popular almanacks, containing much more information, to be had for a shilling or less, and even the *Nautical Almanack* itself costs but half-a-crown, and we cannot conceive any one purchasing the work under notice with that fact in view. We may add that we consider that those who use latin words should make themselves sure of their accuracy. We should have taken *speculæ* for an error of the printer, had it not occurred twice on the same page.

TUTTLE'S COMET.—This object was obseved by M. Borelly, at Marseilles, on October 12. The comet had the appearance of a diffuse nebulosity, badly defined; it appeared elongated in the direction N.W. by S.E.; it was feeble, but of moderate extent, about 2′ 20,″ m.m. Loevy and Tisserand observed it at Paris, October 14; it resembled a diffuse, irregular, whitish nebulosity, diameter about 3′; with a light about equal a star of the 31th magnitude

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions, expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

JUPITER.

Sir,—Now that many telescopes are being turned to this noble planet, the lithographs at the head of this number of the *Register* will, no doubt, be interesting to many of your readers. Perhaps a few remarks on the more notable features lately seen on the disc will also be acceptable.

Those who had the good fortune to see the fine ellipse, which during the winter 1869-70 lay in the bright southern zone, will not soon forget it. So far as I have been able to learn, it was seen only by Dr. Mayer, in Pennsylvania, and Mr. Crossley and myself at Halifax. I first caught sight of it in November, 1869; Dr. Mayer first saw it on the 5th of January, 1870; and it was last seen here on the 29th of March, 1870.

The planet was carefully scrutinized here in October and November of this year; but unfavourable weather prevented us from obtaining a complete set of drawings. On the 1st of December, however, the proper view was secured; and, although the motion was too great to admit of good micrometric measurements, yet a little patient watching enabled me to make a good sketch. At 11½h. p.m., No. 1 was very faint; but near its western end were two small dark spots.

No. 2 appeared much as it is usually seen.

The zone between bands 2 and 3 was very bright, in fact the only bright zone on the planet at this time.

Near the east end of No. 3 were two dark spots.

Under No. 4 were seen the festoons, but they appeared much flatter than usual. Above No. 4 and near the western edge of the disc was a very large dark spot: it was not nearly so dark as those above named, but had rather the appearance of a detached portion of a broad band. It lay upon No. 5. It was broadest where it was in contact with this band. To the east of this object lay the ellipse; within it was seen a short slightly curved dark line: a pretty dark band was in contact with the upper edge of the ellipse. A very rough measure gave 15″ as the length of the longer diameter of this curious object.

On the 4th December, at 10 p.m., the new band in the zone between 2 and 3 was very finely seen: it had two small dark spots on it.

Soon after midnight this new band nearly filled up the bright zone in which it lay, for it now was seen to consist of a number of very broad detached portions nearly connecting bands 2 and 3 together. At this time No. 5 was a fine broad band, but broader in the middle; and No. 1 had a short curved dark streak upon it.

1	...	Nov. 9th	...	12.30 p.m.
2	...	Oct. 9th	...	4.30 a.m.
3	...	Nov. 9th	...	3.15 a.m.
4	...	Dec. 1st	...	11.30 p.m.
5	...	„ 4th	...	10.40 p.m.
6	...	„ 4th	...	12.30 p.m.

I am, Sir, yours very truly,
JOSEPH GLEDHILL, F.G.S., &c.

Mr. E. Crossley's Obervatory,
Park Road, Halifax: Dec. 20, 1871.

VENUS.

Sir,—In the generally accurate report of the November meeting of the Royal Astronomical Society, contained in your last number, there occurs an error to which I wish to call attention, principally because it enables me to refer to a question of some interest.

In page 277, I am reported to have said, during the discussion on a paper by Captain Noble, that I had seen the disc of Venus all round at her last inferior conjunction in September 25-26. I did not observe Venus on that occasion, and what I did say was that Dr. Winnecke had then seen the whole disc of Venus. His observation is printed in the *Astronomische Nachrichten*, No. 1863, page 236, and he there states that he was endeavouring to find how far the extension of the horns of Venus could be traced about the time of conjunction. Observing the planet a little before noon on September 25, with a heliometer of 34 lines in aperture, the horns appeared to him to extend over not more than 180° in all, or about half the circumference. "But," he says, "in the moments of greatest steadiness of the image, the whole disc of Venus appeared to be visible. Although the part of the disc not illuminated by the sun appeared very faint in the gray light, yet there was scarcely a doubt in my mind of the reality of the phenomenon." The weather after that day was not sufficiently good to permit Dr. Winnecke to repeat the observation, and he hoped that other observers were more favoured in that respect. "So far," he concludes, "as I know, the observation of the culmination of Venus by Andreas Mayer, at Greifswalde, on the 20th of October, 1759, is hitherto the only one at which the secondary light of Venus has been perceived near the middle of the day."

The question seems to be interesting as to whether or how far this appearance is due to a secondary light of Venus (or a light diffused over her by a highly refractive atmosphere), or to the fact of the darker body of the planet showing its existence as it were by the effect of contrast on the greyish light of the sky as seen in the telescope. I say, "how far," because it is quite likely that both causes may be operative; but, in as far as the effect seen is due to the latter cause, one would suppose that it would be most marked in the part of the disc of Venus which is farthest from the part illuminated by the sun.

I am, Sir, yours faithfully,
Blackheath: December 13, 1871. W. T. LYNN.

ENCKE'S COMET.

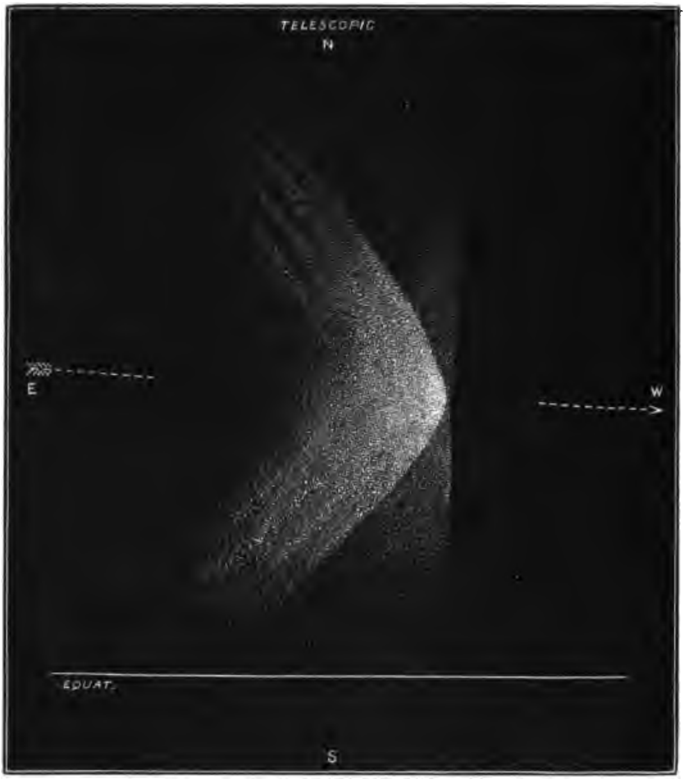
Sir,—I beg to send you the result of an observation of Encke's Comet, made under peculiarly favourable atmospheric circumstances and possessing, I think, considerable interest.

Sir John Herschel in his *Outlines of Astronomy* states that "Encke's Comet has no tail." I believe that statement now requires modification.

On December 3 I observed Encke's Comet with my 8½ inch Browning, with reflector, using a Kellner eyepiece, power of about 60 diameters, the atmosphere being beautifully clear and steady. On first viewing the Comet at a few minutes after 5 p.m., it appeared as the fan-shaped body described by other observers; but, as the twilight diminished and the background became darker, a new feature was apparent. The Comet then presented somewhat the appearance depicted in the annexed sketch. A fan-shaped head from which proceeded, in the opposite direction to the sun, a faint tail, the length of which I roughly estimated at 1¼ times the diameter of the head. The position angle of a straight line running from head to tail of the Comet was about 60°. The tail was exceedingly faint, the north side decidedly brighter and better defined than the south, the

ENCKE'S COMET,

AS SEEN AT THE ROYAL OBSERVATORY, GREENWICH.



From a Drawing by Mr. Carpenter.

curve bounding the head on the preceding side seemed continued down, forming the north boundary of the tail. The Comet was attentively observed till 6·20 p.m., and the sketch is a copy of one made at the telescope.

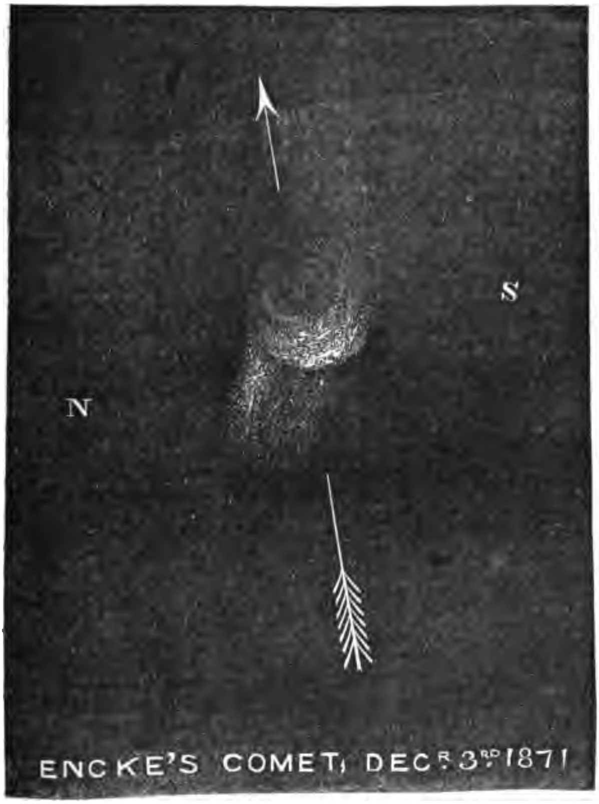
My instrument is in excellent adjustment, and everything my ingenuity could suggest was resorted to, to prove beyond doubt that the tail seen was a *bona fide* appendage to the Comet.

At the November meeting of the Royal Astronomical Society, the Astronomer Royal called attention to the fact that "the tail, if there was such an appendage to Encke's Comet, was turned towards the sun, and in right ascension went first." With the greatest deference to such high authority, I think that view can now be proved to be erroneous.

I trust other observers, with more powerful instruments, will be able to confirm my observation.

I should add that unfavourable weather had prevented any observation for a fortnight prior to December 3, and since that date I have been able to examine the Comet only through haze and fog, and clouds of steam from the breweries in this town, not obtaining a clear view of it for a single instant. I am, Sir, your obedient servant,

63, Guild Street, Burton-on-Trent: E. B. KNOBEL.
December 9, 1871.



ENCKE'S COMET, DEC^{R} 3RD 1871

Sir,—In Encke's formula for the effect of the ethereal medium on the motion of his comet, U, is the constant depending upon the resistance; will some gentleman give its numerical value in the next number of the Register?

Yours truly,
H. PETTY.

FAINT STARS AND HIGH POWERS.

Sir,—In reply to Mr. Lancaster, No. 107, page 258, I have looked through my notes with this general result, with a 2·9-inch refractor and 9-inch reflector: When the limit is about reached, the visibility is in proportion to the power the state of the atmosphere will allow. I have pretty freely used, for experimental purposes, various apertures, ranging between these limits, with similar results. It would be too long a list to give here in illustration, but I have noted exceptions to the general rule, some of which follow:—

ι Cassiop, 2·9-in. ap. 9 mag. distinctly, but best with 74 and 60.
ι Ursæ Maj., 13 mag. 6½-in. ap. 132 better than 212 or 87.
θ Orionis, 5th and 6th; 6½-in. ap. 132 better than 212.
α^2 Capric, 16 mag. 9-in. ap. 132 very much better than 212.

I am inclined to think that the two latter cases arise more from atmospheric difficulties than any peculiarities in the small stars. It will be obvious that the powers which can ordinarily be used on minute points will not be in proportion to the aperture, the unsteadiness of the focal image in large instruments being the great difficulty. This is very obtrusive generally with high powers on the brilliant Alpha Lyræ. Though a beauteous gem, its flashes are not always appreciated by him who is spying out its modest acolyte. On Polaris my experience is contrary to Mr. L.'s. I find it no exception to the general rule.

As to moonlight, it is to be remembered that our satellite is seldom nearer the Pole than 60°, and as often its distance approaches 120°. I have seen the *comes* with 1½-in. ap. reflector (=1⅜-in. refractor) and power 87, when the moon was some degrees above the horizon; and with 132 when the half moon was 90° from Polaris. Under the same circumstances the *debi lissima* in ε Lyræ were readily visible with a clear ap. of 3·3-in. (=3-in. refractor) and power 320; 212 showed them, but required more attention.

Doubtless, the better the *quality* of the telescope, the lower the power *required* to see a given faint star, and the higher the power the said star would bear.

I am, Sir, yours very truly,
T. H. BUFFHAM.

Bonner's Road, Victoria Park:
Nov. 13, 1871.

AURORA BOREALIS.

Dear Sir,—On Friday evening last the Aurora Borealis was seen here to a great advantage. I noticed it first at about 7.30, when it was of a pale white colour, and it gradually increased in brilliancy till 10 p.m., when it changed to a bright crimson, and spread all over the northern quarter of the heavens. It soon, however, returned to the colour on its first appearance, and gradually disappeared towards 1.30.

I am, Sir, yours obediently,
HENRY COX.

Pembroke College, Oxford:
Nov. 13, 1871.

EPSILON LYRÆ.

Sir,—In the Astronomical Register for November there is an interesting communication from Mr. C. Grover, on that beautiful and interesting group known as Epsilon Lyræ. Having of late given considerable attention to this group, I carefully endorse the observations of Mr. Grover.

With respect to the variation of the "Debilissima" couple, I have, on several occasions noticed the change of brightness in these stars. Sometimes one and sometimes the other taking the lead in brilliancy.

In the same Reflector (8½ inch silvered glass by Browning). The three small stars preceding the "Debilissima," and forming a triangular figure, are conspicuous objects, nearly as obvious as the 9th mag. star following the "Debilissima" couple, except the one forming the southern angle. The 15th mag. star, north of the north following star of the "Debilissima," I have, on several occasions, seen, (the nights have to be very fine and bright). This addition, as Mr. Grover remarks, brings up the number of stars composing this group to eleven.—*So I see them.*

I now wish to call the attention of observers, who take an interest in this subject. to a diagram of the late Rev. W. R. Dawes; also to a letter of Mr. A. P. Holden.

In the *Register*, Vol. 2, page 301, there is a diagram from the late Mr. Dawes. Figure the 2nd contains four stars (2 pairs) preceding the "Debilissima" couple; these. with the other members in the diagram, bring up the number of stars composing this group to eleven, the same number as Mr. Grover's. But we must bear in mind the fact that the 15th mag. star, mentioned by Mr. Grover as situated north of the north following-star of the "Debilissima," is not contained in Mr. Dawes's diagram.

In the admirable letter of Mr. Holden (see *Register* of February last), which I have read with pleasure and delight, the following passage is recorded:—"To sum up the whole group as observed upon these several occasions, I think that I may safely put them in the following order of brilliancy, calling the various pairs in their order of distance from a line joining E 1 and E 2. No. 1 (the "Debilissima"), No. 2, No. 3, and No. 4. Here we have no less a number than six stars (3 pairs) preceding the "Debilissima" (two more than in Mr. Dawes's diagram), and, certainly, must bring up the number of stars composing this remarkable group to no less a sum than *thirteen*, and, from what I can see of his (Mr. Holden's) letter, there is no mention whatever of the 15th mag. star.

It would appear, from the diagram of Mr. Dawes, and more particularly from the letter of Mr. Holden, that there are stars between the "Debilissima" couple and the three small stars forming the triangular figure, which my friend Mr Grover and myself have not been able to identify. I have repeatedly looked for them, but up to the present time have not been able to ascertain any. The subject is very interesting, and I hope that other observers, with adequate means, will make a careful search for these minute stars, and communicate their observations.

Yours truly,
HENRY SQUIRE.

New Invention, near Wolverhampton:
November 11, 1871.

CUI BONO?

Sir,—If there be anything in the remarkable theory of Mr. Galton, developed in his work on *Hereditary Genius*, the conclusion seems irresistible that Mr. William Waite, of London, quoted on page 287 of your last number, must be a lineal descendant of the late Mrs. Nickleby. Perhaps I shall best justify this assertion, and show how absolutely cognate were and are the intellectual types of this lady and gentleman referred to, if I quote in parallel columes from their published utterances:—

MR. WAITE.	MRS. NICKLEBY.
"It may interest you to know that some years ago, I saw, what I suppose must have been a planetary body in transit across the sun. A dark speck in the lower limb of the sun caught my eye just about sunset; thinking it to be a sun spot, I got a glass to look at it, but found it to be a globular body of the apparent bigness of an ordinary sized marble, and intensely black. I had not time to notice in which direction it was moving, as the sun dipped almost immediately. Unfortunately, I am not able to recollect what year it was in, but it must have been between June 1860 and June 1863, and I imagine the season was either spring or autumn, as the house fronted nearly due west, and the sun was setting just opposite."	"Roast pig, let me see, on the day five weeks after you were christened, we had a roast—no that could'nt have been a pig either, because I recollect that there were a pair of them to carve, and your poor papa and I could never have thought of sitting down to two pigs—they must have been partridges. It's very odd now what can put that into my head. I recollect dining once at Mrs. Bevan's in that Broad Street, round the corner by the coachmakers, where the tipsy man fell through the cellar flap of an empty house nearly a week before quarter-day, and was'nt found till the new tenant went in—and we had roast pig there. It must be that, I think, that reminds me of it, especially as there was a little bird in the room that would keep on singing all the time of dinner—at least, not a little bird, for it was a parrot, and he did'nt sing exactly, for he talked and swore dreadfully; but I think it must be that. Indeed, I'm sure it must. Should'nt you say so, my dear?"

Seriously, though, I am entitled to ask why the pages of the *Astronomical Register* should be filled with records of such observations. I should be the first to deprecate the introduction of any mere personality into your columns; but now, at the risk of the semblance of it, I cannot refrain from saying, in the interests of a considerable section of your readers, that we are favoured with with a trifle too much of the platitudes of the self-styled Observing Astronomical Society. Might I venture to hint to the Honorary Secretary that quality rather than quantity is what is desirable in such communications as those with which he favours us.

Yours faithfully,
A SUBSCRIBER.

BERTHON'S DYNAMOMETER.

Sir,—I can fully endorse Mr. Levander's remarks, as to the capital results which may be obtained with the Rev. E. L. Berthon's Dynamometer, having given it a careful trial with a number of eyepieces, ranging in magnifying power between 60 and 791. The only point requiring a little care in using it is, the getting an even balance between the illumination of the scale and that of the disc to be measured, otherwise irradiation would render the measures difficult, and the results probably very erroneous. In my experiments I opened the top shutter of my observatory dome towards the north, getting a good direct light on the V. scale, while light was reflected to the object-glass from a sheet of white paper on the opposite side of the observatory.

After I had made trial of the Dynamometer with an ordinary pocket lens of about 1¾-inch focus, Mr. Berthon kindly sent me an ingenious little lens-holder, or microscope, which clips on to the eye-piece of the telescope, and thus leaves both hands free for the V. gauge, adding immensely to the comfort and ease of observing. On receiving it, I repeated my measures of a battery of negative eye-pieces, the magnifying powers of which had been determined by the late Rev. W. R. Dawes,.with, I believe, a double image dynamometer, and the accordance of the three series of measures is so satisfactory, that I am induced to give them here.

Dawes	89	191	258	424	605	791
Knott (1)	91	191	259	425	604	792
Knott (2)	90	192	260	424	604	798

Since my letter of October 16, I have obtained one more set of measures of δ Cygni, with these results: P. = 337°·30, D. = 1″·660, Epoch, 1871·809, Combining the whole series, we have the following mean result: P. = 337°·92, D. = 1″·690, Epoch, 1871·74.

Woodcroft Observatory, Cuckfield, I am, Sir, yours faithfully,
Sussex: Dec. 5, 1871 GEORGE KNOTT.

DYNAMETER OR DYNAMOMETER.

Dear Sir,—Your reply to the enquiry of "Query," given in the current number of the *Register* (p. 294), as to "which is the right appellation of be used in describing the little instrument for measuring the power of eyepieces," is by no means satisfactory to me. As far as I have been able to ascertain from the authorities which I have at hand, I venture to say that both words are in use, and that both are derived from *δυναμις* and *μετρεω*, that they indicate entirely different instruments, and that "the right way of spelling the word" is in fact beside the question.

Dr. Kitchiner in his work "Of Telescopes," p. 238, writes, that "to measure the diameter of the pencil of rays with great ease and accuracy, Mr. Ramsden, about the year 1775, contrived a clever little instrument which he called a *dynameter*." Admiral Smyth says ("Celestial Cycle," I. 382), "various methods of determining the magnifying power of a telescope have been proposed, but Ramsden's double-image *dynameter* has been successfully adopted," and quotes from Dr. Pearson's "full and able" description of the instrument. Mr. Simms also says ("Achromatic Telescope," p. 22). "the *dynameter* is the instrument employed in measuring the image of the object-glass upon the eye-glass."

In the "Encyclopædia Britannica" (7th edition), the *dynameter* is stated (vol. viii. 388) to be an instrument for ascertaining the relative strength of men and animals, and that it resembles a common graphometer, the whole machine weighing only two pounds and a half! Further (vol. ii. 267), "several inventions are said to be in use for ascertaining and comparing the power required to work the plough in different situations; these are known by the name of *dynamometers*, or draught machines, and they all agree in this that the power is determined by a movable index, pointing to figures denoting hundredweights on a dial-plate." Again, (vol. xx. 681) "the *dynamometer* which is generally employed to measure the force of steam in a boiler is a simple tube," &c.

Moreover, in Ogilvie's "The Comprehensive English Dictionary" (Blackie & Sons, 1864), both words thus appear—"DYNAMETER (Gr., *δυναμις* and *μετρεω*), an instrument for determining the magnifying power of telescopes. **Dynamometer**, an instrument for measuring force, especially the relative strength of men and animals (see Dynameter)."

The above extracts conclusively show, as I submit, that both words are correct, that they purposely differ orthographically, to prevent confusion and ambiguity in describing scientific instruments, and that *dynameter* and not *dynamometer* is the proper designation for an instrument to determine the magnifying power of a telescope. If I am wrong in my conclusions, I hope one of your many able correspondents will set me right in the matter.

Yours faithfully,

Upper Holloway : Dec. 11. GEO. WILLIAMS.

[The word dynameter means nothing at all, and so it is a pity some better word, if necessary, has not been coined. If the word be used at all, the form dynamometer is the only admissible one. You might as well, if another instrument for measuring time were required than the chronometer call it a chrometer. It may also be well to notice that in all such words, the derivation is *not* from μετρέω but μετρον. The Greeks never compounded verbs with anything but prepositions.—Editor.]

FUTURE ECLIPSES.

All your correspondents must have been gratified by your publication of Mr. Hind's calculations respecting future Solar Eclipses, both those in the September number, commencing with that of. 1905, and also those for the next twenty years, published in the November number. Let me inform Mr. Hind that he has omitted one fine eclipse, that of May 28, 1900. A computation I have made shows that three-fourths of the Sun's disk are obscured at London that afternoon. In Guillemins' "Heavens," the central path is stated to cross Spain, Algeria, Egypt, and the United States, but one would like to know more particularly. CURIOSUS.

B. A. C. 5554.

Sir,—In the British Association's Catalogue of Stars, and in the compilations from it in Loomis's "Practical Astronomy," and Mr. Proctor's "Handbook of the Stars," the fourth magnitude is assigned to B. A. C. 5554. a star in the southern constellation Ara, now of the sixth magnitude—position for 1850, R.A. 16h. 29m. 42s., S. Dec. 60° 37′ 16″. I am not aware that this discrepancy has ever been corrected. A mistake seems to have arisen in copying from Brisbane's Parramatta Catalogue, where the star in question is marked 7th mag., on the faith of one observation only. This to the Astronomer of N.S.W., Mr. H. C. Russell (who examined the star at my request) appears to have been slightly underrated, as he makes the present magnitude of B. A. C. 5554 equal to the sixth.

Being very much interested with the account given by the late Admiral Smyth, in his charming "Sidereal Chromatics," of the change in colour of 95 Herculis, I watched this star very attentively during the months of July, August, and September this year, with my telescope, an achromatic of 4-ft. focal length, 3-in. clear aperture, and good definition. 95 Herculis attains a meridian altitude at Sydney of 34½°. To me the components of this pair always appear of a fine bright golden yellow, without any trace of the red or green seen by other observers. Several friends to whom the object was shown, all concurred in naming the colours "yellow," or "golden yellow." Have any recent changes been recorded in England ?

I have only lately obtained a copy of Sir J. Herschel's invaluable "Cape Observations," and find that a large proportion of the double and multiple stars contained in that work, can be readily seen with a good

3-in. telescope. Mr. Webb, in his most useful "Celestial Objects," gives a catalogue of southern doubles, but I have already picked out from the "Cape Observations" several (about 80) pairs not included by him, and no doubt shall find others as the season advances. As I do not own a micrometer, only one instance of change in position has been noticed since Sir J. Herschel's time (1834-8), viz, θ Indi, R.A. 21h. 10m., Dec. S. 54°, distance 4″, mags. 5 and 10, a very beautiful double and a fine light-test for small telescopes, mine shows it distinctly. Sir J. Herschel found the position angle measured 307°, not being able to reconcile this with a rough measurement taken by means of a wire inserted in the eye-piece, I asked Mr. Russell to measure the pair accurately for me. This he very kindly did, and finds the position angle to be 292°, thereby establishing a change of position of 15° in about 30 years.

326, George Street, I remain, yours obediently,
Sydney, N.S.W.: Oct. 6, 1871. W. J. MACDONNELL.

JUPITER.

G. M. T.	Zenographical longitude of the centre of ♃'s disc.					Angle of pos. of ♃'s axis.
	8h.	10h.	12h.	14h.	16h.	12h.
1872.	°	°	°	°	°	°
Jan. 0	215	287	0	73	145	12·77
1	6	78	151	223	296	·72
2	157	229	302	14	87	·67
3	307	20	93	165	238	·62
4	98	171	243	316	29	·57
5	249	322	34	107	179	·52
6	40	112	185	258	330	·47
—						
7	191	264	336	49	121	12·41
8	342	54	127	200	272	·36
9	133	205	278	350	63	·31
10	284	356	69	141	214	·25
11	74	147	220	292	5	·20
12	225	298	10	83	156	·14
13	16	89	161	234	306	·09
—						
14	167	240	312	176	97	12·03
15	318	30	103	176	248	11·98
16	109	181	254	326	39	·92
17	259	332	45	117	190	·87
18	50	123	195	268	341	·82
19	201	274	346	59	131	76
20	352	65	137	210	282	·71
—						
21	143	215	288	1	73	11·65
22	294	7	80	152	224	·60
23	85	158	231	303	15	·54
24	235	308	22	94	166	·49
25	26	99	171	244	316	·44
26	177	250	322	35	107	·38
27	328	40	113	186	258	·33
—						
28	119	191	264	336	49	11·28
29	270	342	55	127	200	·23
30	60	133	205	278	350	·18
31	211	284	356	69	141	11·13

Zenographic latitude 1° North.

SUN.

Greenwich, Noon. 1872.	Heliographical longitude of the apparent centre of the sun's disc.		Heliographical latitude of the apparent centre of the sun's disc.	Angle of position of the sun's axis.
	°		°	°
Jan. 1	259·74		—3·23	2·00
2	272·93		3·34	1·51
3	286·11		3·46	1·02
4	299·30		3·57	0·53
5	312·48		3·68	0·04
6	325·66		3·79	359·55
7	338·85		—3·90	359·07
8	352·03		4·01	358·58
9	5·22		4·11	358·10
10	18·40		4·21	357·61
11	31·58	+10 δ ξ	4·32	357·13
12	44·76		4·43	356·65
13	57·95		4·53	356·17
14	71·13		—4·63	355·69
15	84·31		4·73	355·22
16	97·50		4·82	354·75
17	110·68		4·92	354·28
18	123·86		5·01	353·82
19	137·04		5·10	353·35
20	150·23		5·19	352·89
21	163·41	+20 δ ξ	—5·28	352·43
22	176·59		5·37	351·98
23	189·77		5·46	351·53
24	202·96		5·54	351·09
25	216·14		5·62	350·64
26	229·32		5·70	350·21
27	242·50		5·78	349·77
28	255·68		—5·86	349·34
29	268·87		5·93	348·91
30	282·05		6·01	348·49
31	295·23	+30 δ ξ	—6·08	348·07

Assumed daily rate of rotation, 14·2° + δ ξ.

MINIMA OF ALGOL.

According to Prof. Schoenfeld.

1872.	h.	
Jan. 6	15·6	G. M. T.
9	12·4	
12	9·2	
15	6·0	
26	17·3	
29	14·1	
Feb. 1	11·0	

MINIMA OF S. CANCRI.

Jan. 1	12·0h.
20	11·2

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, Midnight		60°N.	0°	60° S.
			Sunset.	
		°	°	°
1872. Jan.	1	+15·0	+15·9	+16·8
	2	+ 2·8	+ 3·7	+ 4·7
	3	− 9·4	− 8·4	− 7·4
	4	21·6	20·6	19·5
	5	33·8	32·7	31·6
	6	46·1	44·9	43·8
	7	−58·3	−57·1	−55·9
			Sunrise.	
	13	+51·2	+49·8	+48·3
	14	39·1	37·6	36·1
	15	27·0	25·4	23·9
	16	14·8	13·3	+11·7
	17	+2·7	+ 1·1	− 0·5
	18	−9·4	−11·1	−12·2
	19	21·5	23·2	24·9
	20	33·6	35·4	37·1
	21	45·7	47·5	49·3
	22	57·8	59·6	61·4
	23	69·9	71·8	73·6
	24	−82·0	−83·9	−85·8
			Sunset.	
	26	+69·9	+71·8	+73·8
	27	57·7	59·7	61·7
	28	45·6	47·6	49·6
	29	33·4	35·4	37·5
	30	21·2	23·3	25·4
	31	+ 9·0	+11·1	+13·3

The sun's disc passes the zone horizon of Linné—

On Jan. 1 from 19·4 to 20·6 setting.
16 „ 15·7 „ 16·9 rising.
31 „ 9·3 „ 10·5 setting.

THE PLANETS FOR JANUARY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	18 51 36 18 45 48	—20 26 —20 18½	10″·0	0 9·7
	15th	18 13 30	—20 56	7″·8	22 32·8
Venus ...	1st	15 38 47	—16 38½	19″·0	20 53·5
	15th	16 45 37	19 57	17″·0	21 5·1
Jupiter ...	1st	7 55 9	+21 14	43″·2	13 11·2
	15th	7 47 25	21 3½	43″·4	12 8·4
Uranus ...	1st	8 9 14	+20 44	4″·2	13 25·2
	17th	8 6 24	20 53	4″·2	12 19·5
Neptune ...	1st	1 21 11	6 42½	0″·2	6 38·3
	17th	1 21 26	6 45	1″·3	5 35·6

Mercury rises a little before sunrise at the beginning of the month, the interval increasing till the middle of the month, after which it decreases.

Venus is excellently situated for observation, passing the meridian at about 9 o'clock in the morning during the month, and so a very favourable object for transit observations during the daytime.

Jupiter may be observed throughout the night, and should be carefully examined by those who have powerful instruments, as all reliable observations of change of colour or markings will be valuable.

Uranus is, like Jupiter, very favourably situated for observation.

LUNAR METEOROLOGY.

BY W. R. BIRT, F.R.A.S.

Under this title we propose occasionally to give notices of such phenomena as may be difficult to account for on variations of the angle of illumination, or may be referred to the action of heat upon the surface of the moon, for as all meterological processes on the earth depend more or less upon the action of heat, so if we are able to detect evidence of the same action on the moon, we may, without employing the term improperly, regard the phenomena observed as partaking of a meteorological character. Change of colour, we know, to be intimately connected with thermal relations, the early spring tints of vegetation, the dark foliage of summer, the rich hues of autumn, alike bespeak the effects of solar heat upon the vegetable covering of the earth. Not that we wish to draw any analogy between colours on the earth and moon, or even to hint in the slightest degree that a lunar vegetation exists, but to direct attention to the fact that, while colour characterises the moon's surface, it is not exempt from changes that can be traced immediately to the action of the sun.

Hitherto, whatever changes of colour or brightness may have been suspected, they have been unhesitatingly referred to changes either of illuminating or visual angles; very few, if any, attempts have been made to *prove* a connection between them and solar influence. The surfaces of the Maria, it is well-known, vary in tint at different periods of the lunar solar day, but whether the *same* tint characterises the *same* surface at the *same* time of day is uncertain. So far as we are aware, only one series of observations exists which bears on this point, it is of the tint of the floor of the walled plain Plato during a period of *two* years. It has long been supposed that, as the sun attains his meridian altitude, the floor becomes darker. This supposition has by the observations been exchanged for certainty, for although the method adopted was one of "estimation," a numerical value has been applied to each estimate of tint, varying from light = 0·33, through medium = 0·50, to dark = 0·66. On projecting the results of the observations for intervals of 12 hours from sunrise to sunset on Plato, the range of tint is found to be equal to 0·41, while that of the sun's altitude is about 40 degrees, the chromatic curve agreeing essentially with that of altitude.

Upon what does this *darkening* depend? Is it on the angle in which the light is reflected to us, or does it not rather depend upon the material of the floor being heated by the sun's rays. During a day of 354 hours duration, we may expect that a large amount of heat will be developed, and as we find on the earth the diurnal march of temperature is proportional to that of the sun's altitude, so we may expect that the diurnal march of lunar temperature will follow the same law, and manifest itself in the gradation of that which is now known in one instance to accompany the sun in his progress through the heavens, thus partaking of the nature of a meteorological process.

At present we have but one solitary instance, and it is very desirable that others should be added. There are numerous dark spots as well as medium and light scattered over the moon's disc. Will they all tell the same tale? It is pretty certain that the surface consists of a variety of material. Is it likely that by multiplying observations we may be able to detect a residual meteorological action, a more or less permanent darkening of certain spots, or of the fading of others. The enquiry is an interesting one, for by it we exchange vagueness for certainty, we obtain an insight into operations which may still be in progress. We know that, as on the earth, igneous action is extensively manifested on the moon, and it is difficult to conceive that when this was in full operation it was unaccompanied by meteorological phenomena. With the cessation of the one, the other may have become greatly subdued, but there is still room for solar action, and we believe that the late researches tend to establish the fact that the surface of the moon is in no small degree acted on by the sun.

In our next paper, we propose to adduce simultaneous instances of clearness and obscurity of neighbouring portions of the moon's surface, which may possibly be connected with solar heat, for it is by no means infrequent that a given area may be seen with great clearness, while an adjoining one is misty and indistinct. The earth view is synchronous, while the areas varying in definition are differences exposed to the sun's rays.

ASTRONOMICAL OCCURRENCES FOR JAN., 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Jupiter.
Mon	1	 16 35 19 29 20 31	Sidereal Time at Mean Noon, 18h. 41m. 49·75s. Inferior Conjunction of Mercury Occultation of ν Virginis (4½) Reappearance of ditto	1st Oc. R. 2nd Sh. I. 2nd Tr. I. 2nd Sh. E. 2nd Tr. E.	7 54 11 23 12 4 14 18 14 59	— 13 11·2
Tues	2	18 33	Conjunction of Saturn and Sun			13 6·7
Wed	3	9 58	☾ Moon's Last Quarter Sun's Meridian Passage, 4m. 33·56s. after Mean Noon	2nd Ec. D. 2nd Oc. R.	6 29 16 9 59	13 2·2
Thur	4	9 10 16 11 16 58 16 43 17 48	Conjunction of Mars and ι Capricorni (3·0m.) E. Occultation of 94 Virginis (6) Reappearance of ditto Occultation of 95 Virginis (6) Reappearance of ditto	1st Ec. D.	18 13 33	12 57·8
Fri	5			3rd Sh. I. 1st Sh. I. 3rd Tr. I. 1st Tr I. 1st Sh. E. 1st Tr. E. 3rd Sh. E. 3rd Tr. E.	14 39 15 31 15 36 15 46 17 50 18 5 18 6 19 6	12 53·3
Sat	6	23 22 21 5 22 7	Conjunction of Moon and Venus, 0° 57′ N. Occultation of β¹ Scorpii (2) Reappearance of ditto	1st Ec. D. 1st Oc. R.	12 42 4 15 12	12 48·8
Sun	7			1st Sh. I. 1st Tr.. I. 1st Sh. E. 1st Tr. E. 4th Ec. D. 4th Ec. R.	10 0 10 11 12 19 12 31 17 39 9 23 30	12 44·3
Mon	8			1st Ec. D. 1st Oc. R. 2nd Sh. I. 2nd Tr. I. 2nd Sh. E. 2nd Tr. E,	7 10 33 9 38 13 58 14 17 16 52 17 12	12 39·8
Tues	9	0 57 16 5	Conjunction of Moon and Mercury, 4° 20′ N. Conjunction of Moon and Saturn, 2° 19′ N.	1st Sh. E. 1st Tr. E. 3rd Oc. R.	6 48 6 56 8 45	12 35·4

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Wed	10	2 57	● New Moon	2nd Ec. D. 2nd Oc. R.	9 5 38 12 13	Jupiter. 12 30·9
Thur	11					12 26·4
Fri	12	3 28	Conjunction of Moon and Mars, 3° 34′ N.	2nd Sh. E. 2nd Tr. E. 1st Sh. I. 1st Tr. I. 3rd Sh I. 3rd Tr. I.	6 10 6 19 17 25 17 29 18 38 18 51	12 21·9
Sat	13	7 11 7 50	Near approach of τ^1 Aquarii (6) Occultation of τ^2 Aquarii (4)	1st Oc. D. 1st Oc. R.	14 36 16 55	12 17·4
Sun	14			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	11 54 11 55 14 13 14 14	12 12·9
Mon	15	3 43	Opposition of Jupiter Illuminated portion of disc of Venus=0·676 „ Mars=0·970	1st Oc. D. 1st Oc. R. 2nd Tr. I. 2nd Sh. I.	9 2 11 21 16 30 16 33	12 8·4
Tues	16		Sidereal Time at Mean Noon, 19h. 40m. 58·11s. Sun's Meridian Passage 9m. 54·43s. after Mean Noon.	4th Tr. E. 4th Sh. E. 1st Tr. I. 1st Sh. I. 3rd Oc. D. 1st Tr. E. 1st Sh. E. 3rd Ec. R.	5 41 5 51 6 21 6 22 8 29 8 40 8 42 12 1 47	Moon. — 5 27·5
Wed	17	0 2 10 33 11 27 11 36 12 32	☾ Moon's First Quarter Occultation af 64 Ceti (6) Reappearance of ditto Occultation of ξ' Ceti (4½) Reappearance of ditto Saturn's Ring : Major Axis=34·11″ Minor Axis=14·25″	1st Ec. R. 2nd Oc. D. 2nd Ec. R.	5 47 47 11 32 14 32 40	6 11·4
Thur	18					6 55·2
Fri	19	10 11 5 52 7 11 14 48	Opposition of Uranus Occultation of B. A. C. 1119 (6) Reappearance of ditto Near approach of B. A. C. 1206 (6)	2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E.	5 37 5 51 8 32 8 45	7 39·7
Sat	20			1st Oc. D. 1st Ec. R.	16 19 18 44 58	8 25·5

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Moon.
Sun	21	11 6 6 39	Conjunction of Venus and ξ Ophiuchi 0° 6′ S. Near approach of *n* Tauri (6)	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	13 38 13 48 15 58 16 8	9 13·0
Mon	22	5 33 4 12 5 10	Conjunction of Venus and ξ Ophiuchi (3·9m.) W. Occultation of 2 Geminorum Reappearance of ditto (6½)	1st Oc. D. 1st Ec. R.	10 45 13 13 32	10 1·9
Tues	23	6 7 6 48. 11 52 13 8	Occultation of ω Geminorum Reappearance of ditto Occultation of 48 Geminorum (6) Reappearance of ditto	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E. 3rd Oc. D. 3rd Ec. R.	8 4 8 17 10 24 10 36 11 44 16 1 9	10 51·7
Wed	24	5 29 15 55 13 38	Conjunction of Moon and Jupiter, 2° 36′ S. Conjunction of Moon and Uranus, 2° 44′ S. Near approach of μ^1 Cancri (6)	1st Ec. R. 4th Oc. D. 2nd Oc. D. 4th Ec. R. 2nd Ec. R.	7 42 10 9 20 13 47 15 42 51 17 8 59	11 41·6
Thur	25	5 14 4 50 5 32	O Full Moon Occultation of γ Cancri (4½) Reappearance of ditto			12 30·5
Fri	26			2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E.	7 51 8 26 10 46 11 21	13 18·1
Sat	27	7 58 8 59 9 48 10 51	Occultation of B. A. C. 3579 (6) Reappearance of ditto Occultation of *i* Leonis (6) Reappearance of ditto	3rd Sh. E. 1st Oc. D.	6 6 18 3	Jupiter. — 11 14·6
Sun	28			2nd Ec. R. 1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	6 27 23 15 23 15 43 17 42 18 2	11 10·1
Mon	29	10 56 13 27	Conjunction of Saturn and Mercury, 0° 6′ S. Near approach of B.A.C. 4104 (6½)	1st Oc. D. 1st Ec. R.	12 29 15 8 2	11 5·7
Tues	30			1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E. 3rd Oc. D. 3rd Ec. R.	9 49 10 12 12 8 12 31 15 1 20 0 46	11 1·2
Wed	31	19 5	Near approach of B.A.C. 4647 (6)	1st Oc. D. 1st Ec. R. 2nd Oc. D.	6 55 9 36 42 16 2	10 56·8

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JANUARY, 1872.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ⊙ Midnight. °	′	Objects to be observed.
13 ...	133	19·5 ...	Hooke, Mercurius, Maclaurin.
14 ...	120	21·7 ...	Mare Fœcunditatis, Palus Somnii.
15 ...	107	53·3 ...	Lacus Somniorum, Daniell, Grove (*a*),
16 ...	95	52·2 ...	Christian Mayer, Büshing, Buch.
17 ...	84	15·3 ...	Epigenes, Scoresby, Calippus.
18* ...	72	58·1 ..	Menelaus, Manilius, Mt. Hœmus.
19 ...	61	55·8 ...	Timocharis, Orontius, Mösting.
20 ...	51	3·4 ...	Davy, Lalande, Lassell (*b*).
21 ...	40	16·5 ...	Euler, Caroline Herschel (*c*), Brayley (*d*).
22 ...	20	31·0 ...	Philolaus, Foucault (*e*), Heraclides.
23 ...	18	43·7 ...	Casatus, Klaproth, Riccioli.
24 ...	7	52·0 ...	Dörfel Mountains, Vasco de Gama.

For additional objects consult the lists for September and November.

* On November 20. 1871, some peculiar phenomena were observed on Plato at sunrise. It will be desirable carefully to examine the floor this evening.

(*a*) On the Lacus Somniorum, between Posidonius and Hercules, are two conspicuous craters, C and D of B and M. It is proposed to designate the nearest to Posidonius DANIELL, in commemoration of the chemist and meteorologist, and the northern crater, midway between it and Hercules, GROVE, to commemorate the labours of the author of the *Correlation of Physical Forces*.

(*b*) Between Straight Wall and Davy, named after the President of the Royal Astronomical Society. It is suspected of having undergone a change of colour.

(*c*) Between Lambert and Mairan is a crater easily found, a ridge extending between it and Lambert. It has been named CAROLINE HERSCHEL, in commemoration of that lady's astronomical labours.

(*d*) In a line with Lambert and Euler is a crater about the same size as "Caroline Herschel," with two smaller ones, E. and W. of it. This has been named in commemoration of the scientific labours of the late E. W. Brayley.

(*e*) Between Bianchini and Harpalus, a little removed on the south from a line joining them, is a crater named FOUCAULT.

During the late winter and spring months, the early moon is well situated for observing objects near the west limb, especially as libration is carrying them east of their mean places in January. The following objects, arranged from north to south, may be noticed between new moon and the 13th, they are all near the limb:

Gauss, Seneca, Plutarch, Neper, Mare Smythii, Käshrer, Ansgarius, Behaim, Hecatœus, Wilhelm, Humboldt, Marinus, Oken, Hanno, Pontécoulant.

Errata.

November, note (*a*) for *marked* read *named.*

December 15, for *Trallis* read *Tralles.* 24, for *Remer* read *Reiner.*

AEROLITE.—A few days ago an aerolite, weighing 127lb., is said to have fallen in the grounds of M. Lepescheur, near Montereau, Seine-et-Marne. It arrived from the east, and burst over the garden with a noise similar to that of a fire of musketry, in the midst of a bright blue light. This bolid, which is of an irregnlar spheroid shape, and black, will be sent to the Academy of Sciences.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1871.

Cooke, T. E.
Elliot, R.
Elvins, A.
Jones, Rev. T.
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Loewy, B.
Ormisher, H.
Petty, T.
Yeates, Miss
Yeates & Son, Messrs.

To Feb., 1872.

Linwood, Rev. W.

To March, 1872.

Finch, A.
Heelis, J.
Surgeon M. Hendry

To April, 1872.

Williams, Prof. Moriere.

To May, 1872.

Hervey, Rev. G.

To June, 1872.

Buffham, T. H.
Glover, E.
Squire, H.

To Dec. 1872.

Baldelli. Comptesse
Baxendell, J.
Gaudibert, Rev. C.
Gilby, J.
Hall, Rev. R.
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Jones, Rev. E.
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Smyth. Prof. Piazzi
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Walker, G. J.

Book received.—Report of the Royal Observatory, Edinburgh, July 27, 1871.

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TO CORRESPONDENTS.

The Greenwich picture of Encke's Comet is unavoidably postponed.

It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

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The Astronomical Register.

No. 110. FEBRUARY. 1872.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Third Meeting, January 12th, 1872.

W. Lassell, Esq., F.R.S., *President,* in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last meeting were read and confirmed. Thirty-nine presents were announced, and the thanks of the Society given to the respective donors. Attention was particularly drawn to two copies of the account of the *Great Trigonometrical Survey of India* and to Schellen's *Spectrum Analysis,* translated by The Misses Lassell and edited by Dr. Huggins, and, it was stated, that the author had expressed his extreme satisfaction at the manner in which the work had been rendered into English.

C. Ragoonochary (Madras Observatory),
W. B. Kemshead, Esq.,
W. Godward, Esq.,
F. J. Marriott, Esq.,
J. H. Winter, Esq., and
C. F. Plant, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

Occultation of Vesta, December 30th, 1871: by Mr. Talmage.

The day had been very wet, but it became very clear at 9h. 30m. p.m. The planet Vesta was quite bright up to the moon's limb. The immersion took place at the bright limb at 10h. 44m. 24·8s. G. M. T., and the emersion at the dark limb at 11h. 52m. 52·6s. G. M. T. These times are exact. Power 80 on 10-in. refractor.

A suggestion on the use of Chronometers: by Mr. D. Gill.

As equal increments of heat do not make equal alterations in the position of the weights of a chronometer balance, there is a resulting uncompensated effect, like the irrationality of the spectrum in a telescope.

Chronometers, adjusted for extreme temperatures, will fail in mean temperatures, and *vice versâ*. Attempts have been made by Hartnup, Loseby, and others, to correct this, but they are not entirely successful. The author suggested the employment of another chronometer, in the same box, which he called the *chronometric-thermometer*, and should be either entirely uncompensated, or have the brass and steel portions of the balance reversed, so as to exaggerate the effects of temperature. This having had its rates in different temperatures tabulated, could be used to correct the other chronometer. He threw out the idea as more especially connected with the expeditions to observe the transit of Venus.

Capt. Noble thought greater perfection could not be reached in the chronometrical determinations of longitudes than in the Astronomer Royal's determination of that of Valentia, which, being afterwards checked by telegraphic signals, came out absolutely identical.

The Astronomer Royal said that, as to the fraction, the chronometer longitude was between the two galvanic results. He need not say that the subject of chronometers occupied much of the attention of all connected with Greenwich Observatory, and that, nine times out of ten, chronometers, when wrong, were so through changes of temperature. Generally, they were now over-corrected; but, formerly, the reverse was the case. This was as to the primary or principal correction. Mr. Gill's paper referred to the secondary alteration. Many years ago this was the subject of communications to the Royal Society by Mr. Eiffe and Mr. Molyneux, which were referred to a committee. Both provided means for this auxiliary compensation which did so approximately. Since that time, other plans have been proposed, notably by Mr. Poole, whose chronometers have gained the first prizes. As to Mr. Gill's suggestion of another chronometer, he did not think any navigator would be troubled with it. One was enough to look after. He would recommend makers to turn their attention to obtaining greater delicacy in the primary compensation. It was well done up to a certain point; but, in the last delicate shade lay the difficulty, and where the difference between high and low temperatures and the mean had to be provided for.

The President inquired whether this was not accomplished by Mr. Hartnup's balance?

The Astronomer Royal said: Not better than by others.

The President thought this nearly perfect.

The Astronomer Royal believed the greater number of the best chronometers were Poole's. He (Mr. P.) made for the trade, so that his balances were sometimes found in instruments bearing other names.

Mr. Gill said, he certainly did not propose his plan for general adoption in navigation, but thought that in any chronometric longitude expeditions no trouble would be considered too great. Mr. Hartnup had recommended him to turn his attention to the subject.

The Astronomer Royal presumed Mr. Gill was aware the plan was used at Greenwich. He also remarked that nobody can appreciate how much depends on the oil. This is a radical point requiring attention. When the oil freezes chronometers go wild.

Professor Cayley mentioned that, with regard to his paper at the June meeting on De Launey's expression *l.g.h.* M. De Launey had accepted his values of the above symbols, and had extended them several terms further.

On the total Solar Eclipse of 1871: Extracts of a letter from Col. Tennant, R.E., to Dr. Huggins.

The author wrote in great haste, on the day of the eclipse, to save the post. The principal points noted were, that six photographs had been taken, and that one having been accidentally injured, five good ones remained. That the chromosphere and prominences first appeared white and then changed through pink to red. Col. Tennant saw two rifts which appearad to him not to reach the moon's edge, but were separated by some minutes of bright corona. The chromospheric* layers were undoubtedly radiated, but not coloured. There were alternate gradations of light—that is, light and comparative darkness, but certainly no colour. The rays were lost as they neared the moon. The rift, at the true vertex of the sun, he is sure, did not change, nor does he believe did any others. The telescope used for these eye observations was of 2½-in. aperture, and power 35. Capt. Morant, observing with a telescope of 1·75-in. aperture, made two sketches. He expressed himself positive as to absence of colour and permanence of rift. He thought, however, that the shades were of sepia tint (brownish), and that the rifts did extend to the moon. Col. Tennant desired to thank Mr. Brothers for his good arrangement of the dark slides.

Dr. De la Rue said that the eclipse of 1871 offered the opportunity of collecting a number of interesting facts along a very extended line. Mr. Ellery, in Australia, had organised some very extensive operations, which it was to be hoped were successful. We knew Col. Tennant had succeeded, and he hoped M. Jansen and the British Association expedition had also prospered. The Astronomer Royal had recently discussed the observations of 1860 and 1870, and the Council trusted that he would allow this report to be published, as part of the Society's transactions. They had also taken action to obtain the observations of the expedition originated by the British Association, and hoped to succeed. The great number of eclipse observations now available must largely increase our knowledge of the physics of the sun.

The Astronomer Royal said that he personally had not done much in discussing the reports of 1860 and 1870. The Joint Committee of the Royal Society and Royal Astronomical Society had asked him to undertake the task, but he had stated that all he could do was to superintend the operation, if some one else would do the real labour, to which the Committee agreed; and Mr. Ranyard had gratuitously undertaken this work, and performed it with an ability that could not be exceeded. He has proceeded so far as to be able to report how many drawings would be required, and had devised modes of comparison which had not occurred to the Astronomer Royal, and which brought out things not before suspected. As the work was going on so well, he had applied to the Treasury for assistance to publish it, but the answer was that they would do nothing at all towards it. This must be looked at charitably, as he thought it meant that they did not want to become publishers of anything, and he had therefore intimated that he only wanted such assistance as had before been given, and the last letter from the Government asked for further information on this point. This he was collecting, and should lay before the Treasury, and he hoped they would see that a great deal of good work had been done, which was well worth publishing. If not, he had the ultimate resource of appealing to the Royal Astronomical Society and the British Association; and, if it could not be a national work, it would, doubtless, be brought out by these bodies.

Dr. De la Rue: The Council have to-day come to the determination that, if required, the Society will bear the whole expense of the publication, as it appears a most fitting time to discuss the result of these solar researches.

The Astronomer Royal was very glad to hear it, and thought the Council had done well in offering to incur this expense if need required.

Observations of Occultations of Stars by the Moon and Phenomena of Jupiter's Satellites: by the Astronomer Royal.

This was the usual annual summary of such observations at Greenwich.

Proposed devotion of a Special Observatory to observations of the phenomena of Jupiter's Satellites: by the Astronomer Royal.

The position which the Royal Astronomical Society holds qualifies it to assume the direction of observations to be made, and I venture to suggest that one observatory should be permanently devoted to the phenomena of Jupiter's satellites. It is known to students of the theory of gravitation, that the system is very peculiar and the results startling, especially in the remarkable enchainment of the first three, and the effect of the mass of the fourth. Since the attempts to determine the mass of Jupiter by Pound, myself, and Bessel, the planet has been somewhat neglected. The errors of the tables are too large for rough time observations, and the observations of the differences are not sufficient to correct the tables by. They cannot be corrected one by one, but must be done altogether. The phenomena occur at irregular times, and interfere with meridional work, although there are long intervals of holiday. The eclipses of the satellites are of the first consequence, and next the shadows on the disc. For this we have the authority of Laplace, and one calculation gives the times of both. The transits and occultations are also good, but require separate tables. The phenomena are very interesting to observe, and something fresh might be detected. I, therefore, recommend that any new observatory should be devoted to this class of observation, and then it may become in future times as well known for its work upon Jupiter's moons, as Greenwich is for its perseverance with respect to our satellite.

The Astronomer Royal, after reading his paper, said that remarks had often been made at the Society, as to the errors of the *Nautical Almanack* tables of these phenomena, but the correction involved more than was generally imagined. And, first, with regard to the theory. Until this had been pursued to its utmost extent, it was useless to attempt to improve the tables. These exhibited a number of terms symbolised by letters, as *m*, *a*, *e*, etc., which had to be multiplied by astronomical coefficients. The letters were mere unmeaning algebraic signs, until their numerical values were determined from old observations. The labour of this was almost incalculable. Mr. Dunkin could speak as to this work in connection with the great reduction of the lunar observations, from Bradley's time to 1830, and afterwards carried on to 1853. The mass of work carried on for several years was enormous. Of one large broadside for calculations, as big as a gravestone, 18,000 were ordered at first, and 4,000 more were required afterwards. This was only one of many forms, and, until they were all filled up, we were not in a position to give any values to the constants. This was by far the largest work which had been undertaken in astronomy. The lunar theory had been worked out by Laplace, Plana, and Lubbock, and having then got the value of the constants, tables could be constructed from which the places of the moon were predicted. The formation of these tables had been undertaken by Hansen, who had laboured hard at them, and his services had been acknowledged by the British Government. The reduction of the observations cost £3,000, and when all this was done, came Mr. Hind's work to make the calculations for the *Nautical Almanack.* If anyone, says Mr. Hind, ought to give better predictions, he can say somebody ought to first give him better tables, theory, and other means of improving his predictions. Laplace worked out the theory of Jupiter, and Delambre and others made the tables. To do better we must go all over the work again, and compare all the observations with the predictions. At present we do not possess sufficient materials, and this is why the observatory is suggested. The lunar theory also required revision as to the points discussed by Adams and Hansen, and the Astronomer Royal wished he were a younger man to undertake it. The Greenwich observations supplied ample means. The next thing was the theory of Uranus, and the observations for this purpose were abundant. In the third place, the theory of Jupiter wants a little working-up, but the main want is that of observations. A new observatory should take up this subject, which is not at present systematically touched.

Capt. Noble said that he should go away, to-night, with a light heart. He had at last got what he had been hammering at for so long—a reason for not doing the work required. So long as it was stated that money was wanted to employ computers, he felt that the government ought to be pressed to find it, but if observations were wanted, time must of course be allowed for their accumulation. As to Uranus, as the observations were sufficient, and mathematicians in plenty, the nation ought to pay any money required, to avoid the disgrace of our tables being six minutes in error.

Mr. Dunkin said the error in the tables of Uranus was only thirteen seconds of time.

Capt. Noble: I speak of the errors of occultations and am perfectly right.

Professor Cayley: We seem to want some sort of board, whose business it should be to work-up the theory and use the observations made.

Capt. Noble did not see why this should be the only country obliged to go begging for its tables.

Dr. De la Rue said that the Astronomer Royal had made a most valuable suggestion. It was necessary to collect materials, and, therefore, a new observatory had been proposed; but, in his opinion, there were observatories enough, and one could well be spared for the work on Jupiter's satellites. It should have a large equatorial, and accurate time and continuous work must be the rule, that no phenomena might be neglected. If this were done for ten years, ample materials would be collected, and then the calculations might be commenced.

Capt. Noble suggested that some guarantee should be given that the observations would be used, and that there should be two such observatories to escape the chances of bad weather.

Dr. De la Rue said no guarantee was necessary, they were sure to be used, and suggested that the telescope should be an 8, 9, or 10-in. achromatic.

Remarks on the Planet Jupiter: by the President (Mr. Lassell.)

As the fourth satellite has begun again to cross the disc, the author observed it on the night of December 30, 1871, and watched part of the passage. At the first entrance on the planet the satellite was hardly distinguishable from the disc, but as it advanced it grew darker, and by the time it was one-fourth across it was almost black. In fact, had Mr. Lassell not known better he would have taken it for a shadow. He had seen the same thing many years ago, but doubts whether it was so dark then. As this can only be an effect of contrast, it shows the brightness of the planet. In like manner, the spots on the sun would not be so dark anywhere else than on the brilliant surface of that body.

On this occasion Mr. Lassell had a most rare and exquisite view of Jupiter, and made a beautiful coloured drawing, which was exhibited. He had been disposed to think the colour in recent pictures was exaggerated, but must now yield up that opinion. He also pointed out the advantage which a newtonian reflector has over a refractor in giving purity of colour. The powers used were 240, 430, and 579, but the latter was too high. The colour was seen best with high power. The full aperture of 24-in. was used. A pencil drawing was also sent for convenience of engraving, on which the colours were marked.

Dr. Huggins said that the President had informed him that Jupiter appeared coloured, but he had not been told what the tints were. He (Dr. H.) looked at the planet last night and made a sketch, which agreed generally with Mr. Lassell's. The reddish belt was a little too pink in his (Dr. H.'s) drawing, and he considered Mr. Lassell's as rather too yellow in the same place.

Mr. Ranyard said that, since the last meeting, he had found some more observations of colour on Jupiter in 1836-7 and 8 and 1848-9.

Rev. J. C. Jackson exhibited six pictures of Jupiter, enlarged from Mr. Gledhill's drawings, during the last months of 1871, and described their details. On January 9, 1872, there were many more belts to the south than had been seen before, and the colours were very bright.

On the probable seat of energy of the Eruption Prominences: by Mr. A. C. Ranyard.

The great velocities observed in the uprushes or vertical storms of the chromosphere were compared with the comparatively slow motions revealed by the spectroscope, as existing in the horizontal currents; and thence it was argued that the uprushes of vapour must be caused by explosions taking place at lower levels. It was suggested that solid masses may be projected upwards, and that the prominences may be vast eddies driven upwards in the wake of such projectiles.

In spite of the high temperature of the sun, calculated by Ericsson, at four million degrees Fahr., and by Secchi at three million degrees centigrade; it was suggested that the vast pressures within the solar globe may be sufficient to reduce many of the elements from the gaseous to a liquid and even solid state. Professor James Thompson's experiments on critical temperatures were referred to as showing that a small alteration of pressure might be the cause of an explosion, if the elements were near their critical temperatures. The prominence observed by Professor Young was instanced as being evidently driven upwards by an explosion.

Usually hydrogen forms the head of such eruption prominences, and they are often "*gonflé*" with heavier vapours at their base, as if a series of layers had been carried upwards in the order of their density. This was considered as affording proof that the cause of such prominences is not an uprush of dense vapour from below, or we should find the dense vapours by reason of their weight travelling furthest in the resisting medium through which they pass, and forming the head instead of the base of such prominences. The theory of impact of one layer upon another driving the outermost and lightest layer furthest was rejected.

Professor Graham believed that the amount of occluded hydrogen in the Lenarto meteor pointed to its formation in an atmosphere of hydrogen under great pressure, such pressure (if it was necessary to look to the sun at all as the laboratory where meteorites are formed) would not be found in the chromosphere, but must be sought for at greater depths. These considerations, taken in conjunction with the flashes across the chromospheric spectrum, observed by Zollner, Vogel, and Howlett, appear to render it probable that solid masses may be hurled from the sun in eruption prominences.

Note on Encke's Comet: by Rev. H. C. Key.

The author sent a number of drawings of the Comet, and stated that he thought the Greenwich picture not a correct representation, as it always, in his 18-in. reflector, preserved an elliptical appearance. He detected a nucleus, and also saw one or more faint rays in the position of a true tail.

On the identity of the Triple Star H. I. 13: by Mr. Hunt.

This paper and drawing were intended to prove the identity of the object in question with one of Struve's compound stars, as originally stated by Mr. Dawes.

On an early transit of Mercury: by Rev. A. Freeman.

Mr. Freeman has found at St. John's College, Cambridge, the records of the observation of the transit of Mercury in 1782, and sent a copy of the time observations made with a 46-in. telescope. Dr. Maskelyne tried to observe this transit at Greenwich, but was prevented by clouds.

On the variable star S Orionis: by Rev. T. W. Webb.

The author had suspected this star to be variable at the beginning of 1870, and was confirmed in his opinion about twelve months ago. It is now showing more variation than ever before, and being well situated for comparison, the changes are easily detected. There is a star of Mr. Baxendell's *d* south preceding, of 11·1 magnitude, and another *e* north preceding, of 11·5, *f* 11·6 is nearly following; *g* on the north is 11·7, and there are two others, *h* and *k* of 12·5 and 12·6 magnitudes. On 5th December last, S Orionis was much fainter than *d* and *e*, and smaller than *f* and *g*, but brighter than *h* and *k*. It may, therefore, be estimated as a little higher than the 12th magnitude, with a period of less than twelve months; but it requires further examination, as it may not yet have attained its minimum.

Mr. Gibbs, Mr. Lynn, and Mr. Perigal having been duly appointed auditors, the meeting adjourned.

Erratum in last Report, page 3, line 17. The time 1m. 18.7s., mentioned by Capt. Noble, was not that of his last glimpse, but the difference between the observed time and that predicted by the *Nautical Almanack*.

THE APPROACHING TRANSIT OF VENUS.

Mr. J. Carpenter, in *Nature*, gives a very interesting account of the preparations being made for the approaching transit of Venus, from which we learn that in Russia a committee has been formed, under Professor Struve, to furnish a chain of observers, at 100 miles apart, along the region between Kamtschatka and the Black Sea. The principal German astronomers have determined to furnish four stations for heliometric observation of the planet during its transit, one in Japan or China, the others probably at Mauritius, Kerguelen's, and Auckland Islands. Three of them, and one station in Persia, between Mascate and Teheran, will be equipped for photographic observations. What the French will do is uncertain. Before the war, it was suggested that they should establish observing stations at St. Paul's Islands and Amsterdam, Yokohama, Tahiti, Noumea, Mascate, and Suez.

It is gratifying to hear that our own preparations are in a more advanced state than those of any other country. The writer goes on to remark that there are several methods by which observers at opposite points may measure the parallactic displacement on the sun's disc—1st, by durations of transit (Halley's method); 2nd, by absolute local times of ingress and egress (Delisle's method); 3rd, by heliometric measures of the planet referred to the limbs of the sun; 4th, by similar measures obtained from photographs of the sun with the planet on his disc. The Astronomer Royal, as a first step, set down stations best applicable for the second method, as that which demanded foremost attention. These had to be selected in order to combine a sufficient altitude of the sun with the maximum attainable acceleration of ingress and retardation of egress on one side of the earth, and retardation of ingress and acceleration of egress on the other side of the earth. Upon weeding out such of these stations as might be expected to be occupied by foreign and colonial observers, it was determined that five stations ought to be equipped by the English Government—viz., Woahoo (for observation of accelerated ingress), Kerguelen's and Rodriguez Islands (for the retarded ingress), Auckland, in New Zealand (for the accelerated egress), and Alexandria (for retarded egress).

Of each of these places the exact longitude must be found, as the absolute local time of the phenomenon is required in each. This will immensely increase the extent of preparations necessary, including the sojourn of the observers for three or four months at each.

To determine the longitude, the Astronomer Royal has determined to employ the method by vertical transits of the moon, the instruments for which observations are to be altitude instruments with 14-in. circles and telescopes of 20-in. focus. For time determinations he proposed 3-in. transits of 36-in. focus, with clocks of moderately high class. For the phenomenon itself each station is to have a 6-in. equatorial and a 4-in. portable telescope. For these an observatory of three rooms will be required. Most of the instruments had to be made on purpose, an estimate for which, to the amount of 2,154*l.*, was submitted to the Admiralty. Supplementary estimates, for conveyance, residence, pay, &c., were prepared by Admiral Richards—viz., for the Woahoo detachment, 2,500*l.*; to Rodriguez and Kerguelen's, 2,000*l.*; for Auckland, 1,000*l.*; Alexandria, 750*l.*; making a total of 8,250*l.*

In 1869 a total of 10,500*l.* was asked for and granted by the Treasury. No time was lost to get everything provided. Most of the instruments and observatories are ready.

It was not at first intended to include photography, on account of uncertainties which were supposed to be inseparable from photographic measurements—but, though all doubt in their correctness has not been removed, yet, this having been done to some extent, through the labours of Mr. Asaph Hall and Mr. De la Rue, and as other nations had resolved to make use of the photographic method, at last it was determined that we should not neglect it, and so an additional 5,000*l.* was asked for and granted for this purpose, and the construction of five photo-heliographs was ordered of Mr. Dallmeyer, similar to that employed at the Wilna Observatory.

The object-glasses will be of about 4-in. diameter, giving focal images of the sun about ½-in. in diameter. The focal image will be amplified to about 4-in. diameter on the photographic plate, and in applying the enlarging lens, Mr. Dallmeyer is confident that he can entirely destroy the spherical aberration. The camera telescopes will be mounted on equatorial stands, with latitude adjustment of 80° range, and they will be furnished with driving clocks.

Mr. De la Rue will superintend the organisation of the photographic department, and supervise the construction of the instruments.

The three stations best suited for photographic observations are Rodriguez, Kerguelen's Island, and Auckland. It is not yet settled whether the heliographs provided for the two other stations might not be better placed elsewhere.

A NIGHT IN THE EAST.

From *A Month's Sojourn on Mount Olivet;* by Mrs. Finn, in *The Scattered Nation*, September, 1871.

Still, how enjoyable was the weather, up here in the mountain air! What could be more delightful than the fresh, dewy mornings, all fragrant with herbs and wild thyme. The still, clear heat by day; the afternoons, when the shadows began to lengthen; the moonlit nights, of surpassing brilliancy, when all the city and the marble courts of the Temple, with airy columns and dusky cypresses, slept in loveliness, unmarred by ought that could disturb eye or ear.

The dark, starry nights were equally enchanting. The evening star that month was Jupiter; after watching him, and finding out his satellites, with help of the telescope, I sought out each bright star with the glass. Presently, having got within range, a planet of tawny hue,—how delighted was I at being able to distinguish the ring of Saturn—the separation between it and the planet, fine as a hair, yet perfectly visible.

Another night, or rather morning, while it was yet quite dark I was awoke by a light streaming in upon my face through the little window that looked eastward, over the shoulders of Olivet. The light came from Venus; there the morning star, gleaming in unearthly beauty, like a small, full moon, over the mountain. By her light alone we could see each other distinctly, and I was able to read the hour upon a small watch.

Long before daylight we were up on the roof-terrace, watching the glories of the firmament. In Jerusalem, the Milky Way has none of the hazy indistinctness which it has here, but spans the sky from side to side, a complete and lustrous bow of stars.

Nothing broke the circle of our horizon. Much as if we had been at sea, or on some wide plain, could we here, from the mountain tops, see the wide expanse of heaven, and watch the constellations from their rising to their setting, in all their liquid and dazzling effulgency which had met the eye of King David long centuries before, and caused him to exclaim, "The heavens declare the glory of God, and the firmament showeth His handy work. Day by day uttereth speech, and night unto night showeth knowledge." Sirius resplendent in the south over the Judean hills, Orion dipping towards the Mediterranean Sea, the Great Bear, the Pole Star, all the familiar constellations, marching onwards in majestic silence. There was to us no thought of sleep, or need of further rest that morning; the whole mind was too fully occupied with the magnificent spectacle, and with the multitude of overpowering thoughts.

Here were the stars as Abraham had seen them, when commanded to try and number them. Here were those ordinances of heaven spoken of by the prophet, "If those ordinances depart from before me, saith the Lord, then the seed of Israel also shall cease from being a nation before me for ever." These stars had silently looked down, as at this moment, upon all the momentous events which had taken place in this Land of Promise, from the night when Abraham looked at them, even until now. They had shone upon prophets, priests, kings, and apostles,—upon the Saviour Himself. They had been set forth as the emblems of the righteous, who shall shine as the stars of the heaven, in various yet in perfect glory. Here, beaming from Olivet over Jerus alem, was also the emblem of Him who is "the Bright and Morning Star'" How pure and soothing was the light from this harbinger of day! There was no wind, the stillness was perfect.

Just before the first glimpse of dawn, this was broken by voices from the minarets in the city. Then came the primitive call to prayer, used in Oriental churches, by striking a wooden plank with a hammer. Thus attention was recalled to time present; the convent bell soon followed; then came pulsations of light, revealing battlements and mountain tops; then daylight, cool and grey; then a thousand lovely tints, upon the landscape and on the fleecy dew-clouds. The shadows fled away, and there appeared the sun-rising, with its magical effects of rosy transparency flung over the city in an instant of time. Just after that followed the bell of Christ Church, ringing the hour for Hebrew morning prayers, and the working day was begun.

Another morning, anxious to see the sun rise over the Moab mountains, we went early, at day dawing, to the eastern brow of Olivet, and thence looked down upon the desolate waste of hill and valley descending to the Jordan plain, lying lonely and sad in the morning light.

There was abundance of dew on all the plants at our feet; the air, clear and cold, was full of their fragrance. The dew was so heavy, that it actually moistened the limestone which peeps out here and there on the top of Olivet, and made it so damp and soft, that I was able, with finger and thumb, to break away the topmost layers, and carry off some specimens, in which fossil shells were embedded.

Far graver and more solemn than sunrise over Jerusalem, was the spectacle of sunrise over the Dead Sea waters, and the empty table-lands of Moab; yet there was exquisite beauty in the soft, lavender-grey tint of the whole landscape, relieved by a rosy cloud or two near the sun at his rising.

Sir John Herschel.—The following inscription, in brass upon a black marble slab, has been placed over the tomb of the late Sir John Herschel, in the north aisle of the Nave of Westminster Abbey.

Johannes Herschel
Gulielmi Herschel
Natu opere fama
Filius unicus
" Cœlis exploratis "
Hic prope Newtonum
Requiescit
Generatio et generatio
Mirabilia Dei narrabunt.
PSALM CXLV. 4, 5.
VIXIT LXXIX. ANNOS,
OBIIT UNDECIMO DIE MAII,
A.D. MDCCCLXXI.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions, expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

NOTES ON JUPITER.

January 9, 1872.—At 9h. 45m. p.m. the air was still, but very misty. With difficulty two drawings were made. The following points are noteworthy.

1. The zone between bands 2 and 3, which has for years been the brightest portion of the disc, is now, in some parts, the darkest. At the above time this zone was full of dark markings; and, together with the coloured zone immediately to the south, gave a very unusual aspect to the disc.
2. Band No. 2, which has for some years been the darkest and broadest, is now, in some parts, fainter than No 3, and some other bands to the south.
3. There was a very fine band to the south of No. 5.
4. And still further south, and nearer to the pole than I ever noticed a band before, was a very distinct broad band.

January 14, 10h. 20m. p.m.—At this time a drawing was obtained, and also one at 11 p.m. The first may be thus described:—

Band No. 2 was much as usual, broad, but not very dark. Between Nos. 2 and 3 was the new band extending quite across the disc; the space on each side of it was fairly bright.

Under No. 4, and in the centre of the disc, was a large ellipse with several small ones on each side of it.

The central zone has certainly lost some of its colour in some parts.

No. 5 was a very fine band, and had its south edge thrown into waves.

To the south of No. 5 a fine band which split up into two at the middle point: one fork ran on to the west parallel to the other bands, while the other diverged a little northwards.

The second sketch shows a series of bright oval spaces under No. 4; but the dark portions, which separate them from one another, are not at right angles to the band, but drift away to the N.E., and some of them seemed to extend quite across the zone in this diagonal direction.

This appearance strongly suggested that in the beautiful drawings of Dawes.

The zone between Nos. 2 and 3 was, at this time, full of grey cloud-like markings.

Mr. E. Crossley's Observatory,
Park Road, Halifax:
Jan. 15, 1872.

JUPITER.

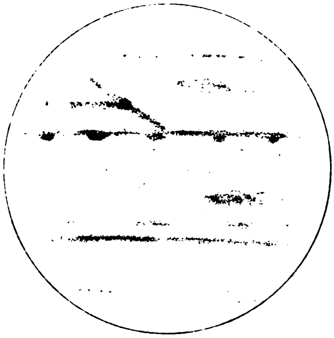
Sir,—My only observations of Jupiter since April 3, 1871, were on the 11th and 13th of the present month when I was truly surprised at the changes in his belts and general appearance. From December, 1869, to the first of the above dates, though he exhibited some variety of feature on different occasions, there was nothing near so striking as the new formations that now appear over his disk. Jupiter's atmosphere, or whatever it is that we see as the face of the planet, appears certainly to be now going through a period of great disturbance, and with a marked progress even since the date of the last of Mr. Gledhill's drawings in your current number. This will be shown by the accompanying rough sketch where some new forms will be seen that up to the above date were not observed by Mr. Gledhill. Of these the most striking is the belt-like streak that descends from the south, crossing the truncated end of 5 at a sharp angle, and reaching down to 4. No. 2 did not seem so dark or so broad as it used to be, and between it and No. 3 was the new imperfect band exactly as described by Mr. Gledhill. The zone between 2 and 3, which formerly appeared to me of a bright greenish color, looks as if it were now about to be filled up and added to the broad dark equatorial zone, as it presents a turbid and mottled appearance on both sides of the new belt, and confuses the previously distinct outlines of 2 and 3. I have not tried to show this in the sketch. The bright zone lying north of 2 seemed to me broader than to Mr. Gledhill. It is probable that the north polar region appeared equally dark to us both, but the opposite area is much darker in Mr. Gledhill's views than I saw it. In fact, in neither of my late observations could I notice without considerable difficulty that it showed any shading whatever, besides some indistinct traces of a belt which I have not sketched.

The great equatorial zone used to appear to me of a rose tint, increasing in depth on each side from the centre where it was very nearly colorless. The centre and southern half of the zone are now equally of a dark shade of red, but the northern half degrades to a slaty hue, which continues across the turbid zone with the new belt between 2 and 3.

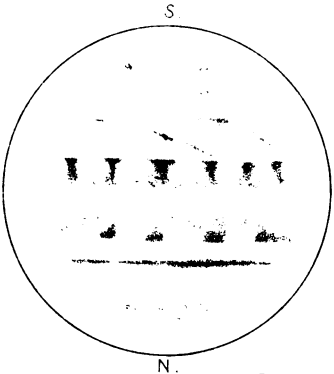
Jan. 15, 1872. J. BIRMINGHAM.

Sir,—On January 6, 1872, 10h. to 10h. 45m., the great southern white belt of Jupiter presented a very abnormal appearance. I have constantly observed the planet on all opportunities for the last few years, but have never before seen so fine a display. After several terrific gales and storms of rain here the atmosphere had settled to a calm, barometer low. The blue depths of the sky *very* dark. A little unsteadiness at times, but generally definition was exceedingly fine.

JUPITER.

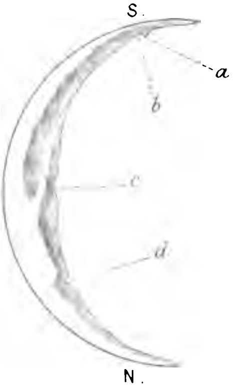


By Mr J. Birmingham, Jan. 1872.



By Mr H. Pratt, Jan. 6th 1872, 10h.

VENUS.



By Mr H. Pratt. Jan. 29th 1870. 5h.

Through the middle of the equatorial zone ran a narrŏw paler band, distinguished not only by its tint, but by its freedom from the mottling which extended over all the darker parts af the zone one either side. On the southern margin of the equatorial zone, a few oval white spots were *very* conspicuous, the spaces between them deepening in tint in proportion to nearness to the southern white belt. The oval white spots appeared nearly detached from the white belt, and their edges were softened. The S. margin of the northern white belt was extended in four places over the equatorial zone, each having a soft cloudy aspect, and slanting N.E. and S.W. Faint shading between these was visible on the N. white belt, while its S. margin was traceable as a *dark line* in the interspaces. The northern white belt was divided its whole length by the darkest of all the belts, slightly widened on the E. The southern white belt was a grand mass of overlapping cloud-like streaks, which can better be understood from the sketch. On its eastern part, just coming into view, was a dusky marking, its western end having an oval outline. Two dusky oblique streaks were easy features, and on close examination they were found connected with a ramification of others. The tints of the various parts of the disc came out finely, and the N. white belt appeared *slightly* tinted with yellowish, as compared with the great S. belt and the cumuli-like shapes on the border, which appeared intensely white. Telescope equatorial, 8¼ With spec. Powers, 304 and 450.

Yours faithfully,
HENRY PRATT.

18, Preston Street, Brighton :
Jan. 16, 1872.

MARKINGS ON VENUS.

Sir,—The interesting discussion respecting the markings on Venus, which took place at the recent meeting of the R.A.S., and a letter upon the subject, which appeared soon afterwards in the *English Mechanic*, from Mr. Birt, remind me that I have been wanting in duty by omitting to record in the pages of the *Astronomical Register* an observation which may be interesting to others although now months old. The delay has been occasioned partly by pressure of my duties and partly from the idea that probably others would describe it. But, as I have met with no published notes of a simultaneous observation, I hasten to atone.

On January 29, 1870, 5h. definition was very fine and Venus exceedingly white. Both cusps very thin and sharp. The first feature which attracted my attention was a tooth of light near the S. cusp (*a*), evidently a spot on the terminator higher than the adjacent regions. It was rendered the more conspicuous by an indentation on one side close to its base (*b*). Other indentations of the terminator were easily seen, one near the equator (*c*), another nearly halfway between this and the northern cusp (*d*). Some delicate shadings were also visible. The sketch was made with the assistance of cross webs. Powers 180 and 270; 90 was insufficient. Telescope 8¼ equatorial With spec. The observation was repeated but not so easily, as the planet showed a slight colour on January 1, 1870, 5h. 10m.

Yours truly,
HENRY PRATT.

18, Preston Street, Brighton :
Jan. 16, 1872.

Ξ *URSÆ MAJORIS.*

Sir,—ξ Ursæ Majoris is now nearly at its periastre, and deserves the especial attention of observers. There were no observations made at its last periastre, in fact none between the years 1804 and 1825. The angular change is at present very rapid, being nearly at the rate of 1° per month. The distance is a little more than 1″.

Temple Observatory; Rugby. J. M. WILSON.

OCCULTATION OF VESTA.

Sir,—Thanks to Mr. Hind's timely announcement, as quoted in the pages of the Astronomical Register, I was enabled to observe, on the beautifully clear night of Saturday, December 30th, the emergence from occultation, at 11.54 p.m., G. M. T., of the little planet Vesta. It emerged from behind the moon opposite some rugged lunar scenery on the Terminator, a little to the north of the striking crater Theophilus, which latter was seen in great beauty at that period of the present lunation.

O.G. 3-in., power 120.

I remain, Sir, yours very faithfully,

East Tisted Rectory, Alton, Hants :
January 1, 1872. FRED. HOWLETT.

OCCULTATION OF VESTA—DARK TRANSIT ON JUIPTER, &c.

Sir,—I have to thank Mr. Buffham for his answer in No. 109, page 14, to my letter in the November *Register*, as to whether high or low powers are best suited for viewing faint stars, though I am sorry to say that my mental vision is not powerful enough clearly to *define* the whole " drift " of his letter.

As regards the occultation of Vesta on the 30th of last month, I was glad to view this asteroid directly after its emersion, through a small refractor of only 2⅞-inches (the night not being sufficiently fine for me to get out my equatorial), but with this small O. G. I failed (as anticipated) to see the immersion of Vesta.

On the same night I had a fine view of the transit of Jupiter's fourth satellite as a *dark spot*, I thought at first it must be a shadow, but on referring to the *N. A.* found otherwise. This transit was in fact distinctly seen as a dark spot (at least two-thirds as black as a shadow), and after an interval of more than 40 minutes from its immersion. I was rather surprised to see this phenomenon so clearly through so small an instrument, but perhaps it is not uncommon. Clouds soon afterwards " eclipsed " Jupiter, so that I could not watch this interesting transit any longer.

St. Aubin's Lodge, I remain, yours faithfully,
Downs' Park Road, Hackney : W. L. LANCASTER.
Jan. 20, 1872.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN FEBRUARY, 1872.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ⊙ Midnight.		Objects to be observed.
	°	′	
11	140	45·2	Palitzsch, Hase, Frauenhofer.
12	128	9·1	Magelhaens, Goclenius, Sautbech.
13	116	1·1	Janssen, Lockyer, Fabricius (*a*).
14	104	18·9	Delambre, Dionysius, Hypatia.
15	92	58·4	Mt. Caucasus, Area IV. A eta Outline Map.
16	81	54·6	Pallas, Bode, Ukert, Murchison (*b*).
17	71	1·9	Purbach, Regiomontanus, Walter.
18	60	14·9	Cichus, Cysatus, Delue.
19	49	28·5	Mare Imbrium, the ridges on it (*c*).
20	38	38·3	Hortensius, Milichius, Bullialdus (*d*).
21	27	40·7	Wollaston, Sinus Roris, Sinus Medii (*e*).
22	16	33·0	Zupus, Vieta, Sinus Œstuum (*e*).
23	5	13·7	Rocca and objects near the East Limb.

For additional objects consult the lists for October and December.

Should any objects not be in sunlight they may be looked for on the following evening.

Linne.—Seeing that the transits of both terminators, evening and morning, over Linné are given on page 21 of the January number, and which will be extremely useful if continued, we may hope that when this interesting object is in sight *on the terminator*, advantage will be taken to examine it rigidly; it would tend greatly to advance our knowledge, and perhaps throw some light on the vexed questions concerning it, if observers were at once to publish their observations. See Vol. 9, pp. 82 and 234.

Lunar Tints.—As it is quite possible to determine by estimation the variation of Lunar Tints, it is recommended that a given surface of small dimensions should be compared from night to night with a neighbouring surface, the north of Julius Cæsar, for example, with Boscovich. An arbitrary scale may in the first instance be employed for this purpose. See article on Lunar Meteorology, on p. 22 of the January number.

The following objects constitute a zone, which with those given in the January list, may be observed between New Moon and the coming into sunlight of the magnificent zone characterised by Laugrenus, Vendelinus, Pitavius, and Furnerius. Subsequent to the 19th they will be west of their mean places, and may be observed with increased foreshortening as the evening terminator passes over them after the time of full moon.

(*a*) See note (*a*) in the September list, the crater on the S.E. of Janssen has been named Lockyer.

(*b*) Mr. Neison is still engaged in this interesting region. We would particularly solicit attention to a fine valley extending from a region just east of the group to the Apennines which Mr. Neison has pointed out; it is well seen as the terminator passes it, but is soon lost as the sun rises above it. The plain to the west of Pallas has been designated Murchison, commemorative of the late distinguished geologist.

(*c*) The systems of ridges on the Maria have not received the attention they deserve since the time of Schröter. They form interesting subjects of study.

(*d*) In the spring of last year, Mr. Whitley, of Truro, called attention to certain crater chains near Bullialdus, it is desirable that the locality should be carefully scrutinised.

(*e*) The aspect of these plains under a high light demands attention: clefts and minute craters should be looked for especially with large instruments.

Mare Humboldtianum, Mercurius, Berosus, Hahn, Oriani, Schubert, Lapeycouse, Phillips,* Legendre, Adams,† Mare Australe.

* Adjoining Wilhelm Humboldt on the east.
† South of Legendre.

Errata.

November 22, for *Uckert*, read *Ukert*.

January list, last line but two, for *Käshrer*, read *Kästner*.

In last line but one *dele* comma between Wilhelm and Humboldt.

In article on Lunar Meteorology, p. 23, line 31, for gradation of *that*, read gradation of *tint*. Same article, p. 23, last line but one, for *differences*, read *differently*.

In Report of the Hackney Scientific Association, Appendix, p. 3, line 26, for *Philip*, read *Phillips*. Last line but three, insert a period (.) after "named." Commence a new sentence with "Up," and insert in the next line the word "was," between moon and treated.

SUN.

Greenwich, Noon. 1872.		Heliographical longitude of the centre of			Heliographical latitude the sun's disc.		Angle of position of the sun's axis.
		°			°		°
Feb. 1	...	308·41		...	—6·15	...	347·66
2	....	321·59		...	6·21	...	347·25
3	..	334·77		...	6·28	...	346·85
4	...	347·96		...	—6·34	...	346·45
5	...	1·14		...	6·40	...	346·06
6	...	14·32		...	6·46	...	345·67
7	...	27·50		...	6·52	...	345·28
8	...	40·69		...	6.57	...	344·90
9	...	53·87		...	6·62	...	344·53
10	...	67·05	+40 δ ξ	...	6·67	...	344·16
11	...	80·23		...	—6·72	...	343·80
12	...	93·42		...	6·77	...	343·44
13	...	106·60		...	6·82	...	343·09
14	...	119·78		...	6·86	...	342·74
15	...	132·97		...	6·90	...	342·40
16	...	146·15		...	6·94	...	342·07
17	...	159·34		...	6·97	...	341·74
18	...	172·52		...	—7·01	...	341·41
19	...	185·71		...	7·04	...	341·60
20	...	198·89	+50 δ ξ	...	7·07	...	340·79
21	...	212·08		...	7·10	...	340·48
22	...	225·26		...	7·12	...	340·18
23	...	238·45		...	7·14	...	339·89
24	...	251·64		...	7·17	...	339·60
25	...	264·82		...	—7·18	...	339·31
26	...	278·01		...	7·20	...	339·04
27	...	291·20		...	7·21	...	338·77
28	...	304·39		...	7·23	...	338·51
29	...	317·58		...	7·24	...	338·25
March 1	...	330·77	+60 δ ξ	...	—7·24	...	338·00

Adopted daily rate of rotation, 14°·20 + δ ξ.

THE PLANETS FOR FEBRUARY.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	19 25 33	—22 13½	5″·9	22 37·8
	15th	20 51 6	19 27	5″·2	23 8·1
Venus ...	1st	18 11 38	—21 51	15″·2	21 24·1
	15th	19 24 9	21 15	14″·0	21 41·3
Jupiter ...	1st	7 38 9	+22 1	43″·0	10 52·3
	15th	7 31 53	22 16½	42″·0	9 51·0
Uranus ...	2nd	8 3 31	+21 1½	4″·2	11 13·7
	14th	8 1 31	+21 7	4″·2	10 24·5
Neptune ...	2nd	1 22 14	+6 50	...	4 33·5
	10th	1 22 49	+6 54½	...	4 2·6

Mercury is well situated for observation at the beginning of the month.

Venus rises at the beginning of the month 2h. 20m. before the Sun, the interval decreasing.

Jupiter is well situated for observation throughout the night.

Uranus is also well situated for observation.

COMET V., 1871.

The following elements of this Comet are by C. F. W. Peters, of Altona.

Perihelion Passage ... = 1871 Dec. 20·43
° ′
Longitude of Perihelion = 28 43
Longitude of Ascending Node = 146 45
Inclination ... ... = 98 50
Longitude *q* ... ... = 9.84587

The following ephemeris will be useful to some of our readers in the Southern Hemisphere:—

1872.		R. A.		Decl.
		h. m. s.		° ′
Feb. 2	...	14 42 0	...	—84 43
12	...	8 25 18	...	73 40
22	...	7 46 42	...	51 32
March 3	...	7 39 6	...	26 26
13	...	7 39 30	...	12 47
23	...	7 43 49	...	— 1 46

ASTRONOMICAL OCCURRENCES FOR FEB., 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Jupiter
Thur	1	22 10	☾ Moon's last quarter Sideral Time at Mean Noon, 20h. 44m. 3·02s.	1st Tr. E. 1st Sh. E. 4th Tr. I.	6 34 7 0 15 37	10 52·3
Fri	2			2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E.	10 6 11 1 13 1 13 56	10 47·9
Sat	3	15 31 16 34	Occultation of ω Ophiuchi (5) Reappearance of ditto	3rd Sh. I. 3rd Tr. E. 3rd Sh. E.	6 36 8 11 10 6	10 43·5
Sun	4		Sun's Meridian Passage 14m. 8·97s. after Mean noon	2nd Ec. R. 1st Tr. I. 1st Sh. I.	9 3 36 17 7 17 38	10 39·1
Mon	5	17 32	Conjunction of Moon and Venus 2° 51′ N.	1st Oc. D. 1st Ec. R.	14 14 17 2 41	10 34·7
Tues	6	7 41	Conjunction of Moon and Saturn 2° 36′ N.	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	11 33 12 6 13 53 14 26	10 30·3
Wed	7	0 12	Conjunction of Moon and Mercury 2° 10′ N.	1st Oc. D. 1st Ec. R.	8 40 11 31 24	10 25·9
Thur	8	13 51	● New Moon	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	6 0 6 35 8 19 8 54	10 21·5
Fri	9			1st Ec. R. 2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E. 4th Oc. D.	6 0 3 12 23 13 37 15 18 16 32 23 41	10 17·1
Sat	10	2 54	Conjunction of Moon and Mars 4° 32′ N.	3rd Tr. I. 4th Ec. R. 3rd Sh. I. 3rd Tr. E. 3rd Sh. E.	8 2 9 50 38 10 35 11 31 14 5	10 12·7
Sun	11	4 28 5 24 7 41	Occultation of 33 Piscium (5) Reappearance of ditto Near approach of B.A.C. 17 (6)	2nd Oc. D. 2nd Ec. R.	7 28 11 39 44	10 8·3
Mon	12	9 22	Occult. of 26 Ceti (6½)	1st Oc. D.	15 59	10 4·0
Tues	13	20 16	Conjunction of Saturn and Venus 0° 33′ N.	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	13 19 14 1 15 38 16 21	9 59·6
Wed	14		Illuminated Portion of disc of Venus 0·773 „ Mars 0·982	1st Oc. D. 1st Ec. R.	10 26 13 26 14	9 55·3
Thur	15	18 23	☽ Moon's First Quarter Sun's Meridian Passage, 14m. 24·97s. after Mean Noon	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	7 46 8 30 10 5 10 49	9 51·0

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Fri	16		Sidereal Time at Mean Noon, 21h. 43m. 11.34s.	1st Ec. R. 2nd Tr. I. 2nd Sh. I.	7 54 55 14 42 16 14	9 46·7
Sat	17	6 28	Near approach of ι Tauri (5) Saturn's Ring: Major Axis 34·50" Minor Axis 14·13"	3rd Tr. I. 3rd Sh. I. 3rd Tr. E.	11 26 14 34 14 55	9 42·4
Sun	18	13 25 14 12	Occultation of 2 Geminorum (6½) Reappearance of ditto	4th Tr. I. 2nd Oc. D. 4th Tr. E. 4th Sh. I. 2nd Ec. R.	6 18 9 47 10 28 13 47 14 15 49	9 38·1
Mon	19	15 8 15 39	Occultation of ω Geminorum (6) Reappearance of ditto			9 33·9
Tues	20	6 41 20 42	Conjunction of Moon and Jupiter, 2° 10′ S. Conjunction of Moon and Uranus, 2° 36′ S.	2nd Tr. E. 2nd Sh. E. 1st Tr. I. 1st Sh. I.	6 46 8 27 15 6 15 56	9 29·6
Wed	21	13 29 14 31	Occultation of γ Cancri (4½) Reappearance of ditto	3rd Ec. R. 1st Oc. D. 1st Ec. R.	8 1 53 12 13 15 21 12	9 25·4
Thur	22			1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	9 32 10 25 11 52 12 44	9 21·1
Fri	23	22 56 12 33 13 2	○ Full Moon Occult. of 42 Leonis (6) Reappearance of ditto	1st Oc. D. 1st Ec. R.	6 39 9 49 55	9 16·6
Sat	24			1st Tr. E. 1st Sh. E. 3rd Tr. I.	6 19 7 13 14 54	9 12·7
Sun	25			2nd Oc. D. 2nd Ec. R.	12 8 16 51 50	9 8·5
Mon	26			4th Oc. D.	14 44	9 4·3
Tues	27			2nd Sh. I. 2nd Tr. E. 2nd Sh. E. 1st Tr. I.	8 8 9 8 11 3 16 53	9 0·2
Wed	28	13 40	Near Approach of 2 Libræ (6)	3rd Oc. R. 3rd Ec. D. 3rd Ec. R. 1st Oc. D.	8 9 8 38 42 12 2 0 14 1	8 56·0
Thur	29			2nd Ec. R. 1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	6 9 41 11 20 12 20 13 40 14 39	8 51·9
MAR Fri	1			1st Oc. D. 1st Ec. R.	8 28 11 45 2	8 47·8

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, Midnight		60°N.	0°	60° S.
			Sunset.	
		°	°	°
1872. Feb.	1	− 3·2	− 1·0	+ 1·1
	2	15·4	13·2	−11·0
	3	27·6	25·4	23·2
	4	39·7	37·5	35·3
	5	51·9	49·7	47·4
			Sunrise.	
	10	+71·7	+69·3	+66·9
	11	59·6	57·1	54·7
	12	47·5	44·9	42·5
	13	35·3	32·7	30·3
	14	23·0	20·6	18·1
	15	+10·9	+ 8·4	+ 5·9
	16	− 1·3	− 3·8	− 6·3
	17	13·4	15·9	18·4
	18	25·6	28·1	30·6
	19	37·7	40·2	42·8
	20	49·8	52·3	54·9
	21	62·1	64·5	67·1
	22	−74·3	−76·7	−79·3
			Sunset.	
	24	+76·4	+79·0	+81·6
	25	64·3	66·9	69·5
	26	52·1	54·7	57·4
	27	40·0	42·6	45·2
	28	27·8	30·4	33·1
	29	15·6	18·3	20·9
March	1	+ 3·5	+ 6·1	+ 8·8

The sun's disc passes the true horizon of Linné—
On Feb. 15 from 6h. 7m. to 7h. 9m. G. M. T. rising.

THE PLANET VESTA.

The Minor Planet *Vesta*, whose occultation we recorded in No. 108, No. 4 of the series comes to opposition on the 5th of this month. She is in the constellation Leo, and is barely visible to the naked eye, her magnitude being between the 6th and 7th. The following are her positions at transit over the meridian at Greenwich.

	R. A.			Dec.		
	h.	m.	s.	°	′	″
Feb. 1	9	30	4	+21	32	59
5	9	26	4	22	4	3
10	9	20	59	22	40	58
15	9	15	55	23	14	48
20	9	11	5	23	44	42
25	9	6	39	24	10	6

JUPITER.

G. M. T.	Zenographical longitude of the centre of ♃'s disc.					Angle of pos. of ♃'s axis.
	6h.	8h.	10h.	12h.	14h.	12h.
1872.	°	°	°	°	°	°
Feb. 1	289	2	75	147	220	11·08
2	80	153	225	298	10	11·03
3	231	304	16	89	163	10·98
4	22	94	167	240	312	10·93
5	173	245	318	30	103	10·88
6	323	36	109	181	254	10·83
7	114	187	259	332	44	10·78
8	265	338	50	123	195	10·74
9	56	128	201	273	346	10·70
10	207	279	352	64	137	10·66
11	357	70	142	215	288	10·62
12	148	221	293	6	78	10·58
13	299	11	84	157	229	10·54
14	90	162	235	307	20	10·50
15	240	313	26	98	171	10·46
16	31	104	176	249	321	10·42
17	182	255	327	40	112	10·38
18	333	45	118	190	263	10·35
19	123	196	269	341	54	10·32
20	274	347	59	132	204	10.29
21	65	137	210	283	355	10·26
22	216	288	1	73	146	10·23
23	6	79	152	224	297	10·20
24	157	230	302	15	87	10·17
25	308	20	93	166	238	10·14
26	99	171	244	316	29	10·11
27	249	322	34	107	179	10·09
28	40	113	185	258	330	10·07
29	191	263	336	48	121	10·05

Zenographical latitude 1°·0 North.

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TO CORRESPONDENTS.

The Greenwich picture of Encke's Comet is unavoidably postponed.

It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 111. MARCH. 1872.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Fourth Meeting, February 9th, 1872.

The Annual General Meeting.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last annual general meeting, and of the special general meeting for the alteration of the bye-laws relating to the award of the medal, were read and confirmed.

E. H. Cooper, Esq.,
J. H. Esdaile, Esq.,
J. Engleson, Esq.,
Capt. Herschel. R.E., F.R.S.,
D. L. Lowson, Esq.,
J. Martin, Esq.,
Capt. O'Reilly,
E. Roberts, Esq.,
and J. Wall, Esq.,

were balloted for, and duly elected Fellows of the Society.

The report of the Council (of which the following particulars are only a brief summary) was partly read by the Secretaries. It commences with the auditors' report on the treasurer's accounts, which show that the income for the past year was 1,410*l.* 4*s.* 2*d.*, and the expenditure, including the purchase of 200*l.* stock and the grant of 250*l.* in aid of the Eclipse expedition of 1870, was 1,138*l.* 10*s.* 7*d.*, leaving a balance of 271*l.* 13*s.* 7*d.*

The total number of Fellows and Associates is 552, being two less than last year.

The Council have awarded the gold medal to Signor Schiaparelli, of Milan, for his researches on the connexion between the orbits of comets and meteors. Part I. of Vol. XXXIX. of the *Memoirs*, containing a paper by Professor Cayley, "On the Graphical Construction of a Solar Eclipse," has been published, and a general index to the 38 volumes of the *Memoirs* compiled and distributed.

The list of deceased Fellows is long, and comprises some of the most distinguished men of science, including Sir J. Herschel and Mr. Babbage, the last survivors of the founders of the society in 1820.

The list is as follows:

Charles Babbage, Esq., F.R.S.
Capt. J. P. Basevi, R.E.
Rev. A. W. Deey.
Augustus De Morgan, Esq.
Lt.-Gen. Sir W. T. Denison, K.C.B., F.R.S.
Earl of Dunraven, F.R.S.
Commander R. W. H. Hardy, R.N.
Sir J. F. W. Herschel, Bart., F.R S.
Sir A. Lang.
Sir Roderick I. Murchison, Bart., K.C.B., F.R.S.
Admiral Sir W. Ramsay, K.C.B.
William Rutherford, Esq., LL.D.
Charles E. Smith, Esq.
Capt. David Smith.
Rev. W. Taylor, F.R.S.
Rev. T. W. Weare.

The report contained most interesting biographical notices of most of these Fellows, but extracts from two only, viz., those of Sir J. Herschel and Professor De Morgan, could be read. We may probably hereafter recur to some of them.

The reports of the various Observatories include Greenwich, Oxford, Cambridge, Dunsink (Dublin), Stonyhurst, Liverpool (Bidston), Kew, Durham, Edinburgh, Glasgow, the Cape of Good Hope, and Sydney.

At Greenwich, the printing of the reductions for 1870 is completed, and for 1871 far advanced. The water telescope has been used for observing γ Draconis, instead of the reflex zenith tube, with the results to be presently noted. The graduations and flexure of the transit circle have been re-examined, Jupiter's satellites, Venus, and Encke's Comet have been carefully observed in addition to the usual work. A new sidereal clock has been mounted in the magnetic basement, where the temperature is nearly uniform, with the result of making any change in the clock rate almost inappreciable. What little alteration does take place seems dependent on atmospheric pressure.

At Oxford the regular astronomical and meteorological work has been carried on, the reductions well advanced in printing, and materials for a third catalogue of stars accumulated. The new transit circle at Cambridge has been employed in observing a zone of small stars, and some improvements have been made in the instrument. Encke's Comet has also been observed. Professor Chevalier has resigned the directorship of the Durham observatory. Minor Planets and Encke's Comet have been observed; also, the spectrum of the Aurora Borealis, but only the well-known green line was seen. At Dunsink, Dr. Brunnow has observed the parallax of five stars: 1,830 Groombridge, 3,077 Bradley, 85 Pegasi, 6 Draconis, and α Lyræ, the results of which will soon be published. He has also commenced work on the planetary nebula H iv. 37 and on 61 Cygni. A new transit circle is being erected. At Stonyhurst, the sun spots are photographed on a large scale, and a magnetic survey of Belgium has been made. A time gun has been established at Birkenhead (Liverpool), and nearly 400 chronometers tested. The weather having been very favourable at Kew, 381 photograms have been obtained on 226 days, and two papers, one on the form of the sun spot curve, and the other on its interplanetary relations, have been communicated to the Royal Society. The photographic operations for a spot period of 10 years have now been completed, and comprise 2,778 photograms and 20 papers. The observations at Kew will now be discontinued, but it is hoped will be kept up at Wilna, and probably, after an interval, will be resumed by Dr. De la Rue.

The report then deals with the progress of astronomy during the past year, and gives the greatest prominence to the important results of the late Total Solar Eclipse. With the exception of Australia, and one Indian station, the weather was most favourable and the reports most satisfactory.

The Madras astronomer, Mr. Pogson, observed at Avenashy. He telegraphed to the Astronomer Royal, "Weather fine, telescopic and camera photographs successful, ditto polarisation; good sketches; many bright lines in spectrum."

Colonel Tennant, who through the liberality of Lord Mayo had been able to organise a strong observing party, including Capt. Herschel and Mr. Hennessey, selected the old meteorological station of Dodabetta, on the highest peak of the Neelgherries, 8,650 feet above the sea. He telegraphed his principal results in the following words, "Thin mist, spectroscope satisfactory. Reversion of lines entirely confirmed. Six good photographs."

His subsequent letter was read at the last meeting of the society and duly abstracted in the *Astronomical Register*, and in the present number will be found a translation of Dr. Janssen's letter to the President, also quoted in the report.

From the British Association expedition the following reports have been received:

Mr. Lockyer, who observed at Bekul, speaking of the corona says, "Its rays arranged almost symmetrically, three above and three below two dark spaces or rifts at the extremities of a horizontal diameter. The rays were built up of innumerable bright lines of different lengths, with more or less dark spaces between; near the sun this structure was lost in the brightness of the central ring. I next tried the spectrum of a streamer above the point at which the sun had disappeared. I got a vivid hydrogen spectrum with 1474 (I assume the point of this line from observation) slightly extended beyond it, but very faint throughout its length compared with what I had anticipated, and thickening downwards like F. I was, however, astonished at the vividness of the C line and of the continuous spectrum, for there was no prominence on the slit; the spectrum was undoubtedly tho spectrum of glowing gas. In the Savart I saw lines vertical over everything, corona, prominences, dark moon, and unoccupied sky." With a simple train of prisms Mr. Lockyer saw "four exquisite rings with projections where the prominences were. In brightness C came first, then F, then G, and last of all 1474. The rings were nearly all the same thickness, certainly not more than 2′ high, and they were all enveloped in a line of impure continuous spectrum." "The structure of the corona was simply exquisite and strongly developed," I at once exclaimed, "Like *Orion*. Thousands of interlacing filaments varying in intensity were visible. I saw an extension of prominence structure in cooler material. This died out somewhat suddenly some 5′ or 6′ from the sun, and there was nothing. The great fact was this, that close to the sun, and even for 5′ or 6′ away from the sun, there was nothing like a ray or any trace of radial structure." At this station, five good photographs were obtained.

Commander Maclear observing at the same station says, "As totality came on, the light decreased and the lines increased exceedingly rapidly in number and brightness, until it seemed as if every line in the solar spectrum was reversed; then they vanished, not instantly, but so quickly that I could not make out the order of their going, except that the Hyd. D *b*, and some others between D and *b*, remained last. Then they vanished and all was darkness. I then unclamped and swept out right and left, but saw nothing; then went to the direct vision, but saw nothing; placed the telescope on the Moon's limb by the eyepiece, then put in the spectroscope, but the light was not sufficient to show any spectrum; pointed the telescope carefully first on the dark Moon, and then on a bright part of the corona, but no spectrum. I then looked at the corona with the naked eye, saw a bright glory round the moon, stellar form, six-pointed, something like the nimbus painted round a saint's head, extending to a diameter and a half. Looked through the finder and saw the same form, but very much reduced in size and brilliancy, then examined with the 6-inch and eye-piece and saw nothing but a bright glow round the Moon, not much more than the height of the big prominence plainly visible in the south-east quarter."

Prof. Respighi observed at Poodocottah. He writes, "Towards the end of 1868 a small flint-glass prism was made for me by Signor Merz, of Munich, to be fitted to the object-glass of the equatorial of the observatory at Campodaglio. This apparatus, in consequence of the dispersion of the prism, and the goodness of the prism and object-glass, was found to be admirably adapted for observing the eclipse in the manner just described (that is, without a slit, so that the several chromatic images of the corona would be simultaneously seen in the same field of view).

"The dispersion of the prism from lines C to H is about 32′; the free aperture of object-glass is $4\frac{1}{8}$ French inches; the field of the telescope about 1°, with a magnifying power of 40." "At the very instant of totality, the chromosphere at the edge which was about to be eclipsed—surmounted for a space of about 50° by two groups of prominences, one on the right, the other on the left of the point of contact—were reproduced in the four spectral lines C, D^3, F, G. My attention was mainly directed to the comparison of the forms of the prominences on the four spectral lines, and I was able to determine that the fundamental form, the skeleton or trunk, and principal branches, were faithfully reproduced or indicated in the images, their extent being, however, greatest in the red, and diminishing successively in the other colours down to the line G, on which the trunk alone was reproduced. In none of the prominences thus compared was I able to distinguish in the yellow image D^3 parts or branches not contained in the red image C. Meanwhile the coloured zones of the corona became continually more marked, one in the red corresponding with the line C, another in the green, probably coinciding with line 1474 K, and a third in the blue, perhaps coinciding with F.

"The green zone surrounding the disk of the Moon was the brightest, the most uniform, and the best defined. The red zone was always distinct and well defined, while the blue zone was faint and indistinct. The green zone was well defined at the summit, though less bright than at the base; its form was sensibly circular, and its height about 6′ or 7′. The red zone exhibited the same form and approximately the same height as the green, but its light was weaker and less uniform. These coloured zones shone out upon a faintly illuminated ground without any marked trace or colour. If the corona contained rays of any other kind, their intensity must have been so feeble that they were merged in the general illumination of the field. . . . . The spaces between some of the jets (prominences) were perfectly dark, so that the red zone of the corona appeared to be entirely wanting there. Perhaps, however, this was only an effect of contrast due to the extraordinary brightness of the neighbouring jets.

The discussion of these and other observations, and photographs when received, will, there can be little doubt, throw great light on the nature and extent of the coronal light and rays.

With respect to spectrum analysis generally, Dr. Zöllner has contrived a more simple form of reversion spectroscope, by which the principle of doubling the change produced in the refrangibility of a line can be applied to any spectroscope.

With this instrument Zöllner has succeeded, with the assistance of Dr. Vögel, Director of the observatory at Bothkamp, in detecting the change of refrangibility due to the Sun's rotation. The estimations of the amount of the change subsequently made by Dr. Vögel are in excess of the period of rotation obtained from observations of solar spots, the equatorial velocity ranging from 0·35 to 0·42 mile in a second, while the received value is 0·27 mile.

Professor Young was fortunate in observing an ejection of matter by an apparent explosion in the Sun, which took place on Sept. 7. At noon on that day he observed an enormous protuberance of hydrogen cloud on the eastern limb of the Sun. It had remained with little change since noon of the preceding day. It was made up mostly of filaments nearly horizontal, with its lower surface at a height of some 15,000 miles; but was connected with the layer of red hydrogen by three or four vertical columns, brighter and more active than the rest. Returning to the telescope half-an-hour later, Professor Young found, in place of the quiet cloud, a mass of detached vertical fusiform filaments rapidly ascending. Some of them had already reached a height of 100,000 miles, and they continued to rise with a motion almost perceptible to the eye until, in ten minutes, the uppermost were more than 200,000 above the solar surface, the velocity of ascent was therefore 166 miles per second. Mr. Proctor has made some valuable suggestions as to the conclusions to be drawn from this occurrence.

Father Secchi has suggested a modification of the usual spectroscopic method of viewing the prominences which may be of service in some observations. He places a prism before the object-glass of the astronomical telescope, or else a direct-vision spectroscope within the telescope, some 6 or 8 inches in front of the slit of the ordinary spectroscope. By this arrangement the Sun's disk can be viewed in the spectroscope; and if the slit be placed on a prominence near the solar limb, and the spectroscope arranged for the position of C, then, together with the solar limb, will be seen a bright line of the prominence at a distance from the Sun's limb, depending on the position of the slit relatively to the solar image, but not exceeding the height of the prominence under observation.

We are also indebted to the ingenuity of Father Secchi for a new method of measuring the height of the prominences seen in the spectroscope, the details of which will be found in the *Comptes Rendus* for December 4, 1871.

Professor Young has done a very valuable service to spectroscopic observers of the Sun, by publishing a catalogue of all the lines which have been observed in the solar prominences and corona.* These lines, 103 in number, are arranged in the order of their wave-lengths, and the corresponding numbers of Kirchhoff's maps are given. Other columns of the catalogue contain the relative brightness and frequency of the lines, and the names of the chemical elements to which they belong. No fewer than twenty of the lines are due to the vapour of titanium. Besides the well-known coronal line 1474 of Kirchhoff's scale, two other fainter lines, one less refrangible than C, and the other between F and G, appear, according to Professor Young, to be persistently present in the corona or chromosphere, and probably to be due to the matter of which it consists, and not, as is the case with most of the other lines, to the occasional elevation of matter to heights where it does not properly belong.

Dr. Huggins has succeeded in observing the spectrum of the planet *Uranus*. His results differ in many important respects from those obtained by Father Secchi, in 1869. It will be remembered that Father Secchi described the spectrum of *Uranus* in the following terms, "Le jaune y fait complétement défaut. Dans le vert et dans le bleu il y a deux raies très-larges et très-noires." He also represented the band in the blue as more refrangible than F, and the one in the green as near F. In Dr. Huggins' instrument the spectrum appears differently. He finds the spectrum of *Uranus* continuous, no part being wanting so far as the feebleness of its light permits it to be traced, which is from about C to about G. The absorption taking place at *Uranus* shows itself in six strong lines. One of these, the most refrangible, appeared to be coincident with the line F of hydrogen, with which line (in the spectrum obtained from rarefied hydrogen, rendered luminous by the induction spark) it was directly compared. The positions of this and four other lines were also obtained by micrometrical measures. There is no strong line in the spectrum of *Uranus* in the positions of the strongest lines of air, namely, the double line of nitrogen. There are no absorption bands in the position of the line of sodium, or in that of any line of carbonic acid gass.

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* This List is reprinted in Schellen's *Spectrum Analysis*.

Dr. Huggins has also examined spectroscopically the light of Comet I. 1871, discovered by Dr. Winnecke, and of Encke's Comet. Both comets gave a spectrum of three bright bands, agreeeing in position with the principal bands of the spectrum of carbon, and similar to the spectra of former comets examined by Dr. Huggins.

The list of Minor Planets has been increased by five since the last Annual Report. The total number at the present time is *one hundred and seventeen.* The new members of the group are :—

1. *Amalthœa* (113), discovered on 1871, March 12, by Dr. R. Luther, at Bilk, near Dusseldorf.
2. *Cassandra* (114), discovered on July 24, by Dr. C. H. F. Peters, at Hamilton College, Clinton, New York.
3. (115), discovered on August 6, by Mr. Watson, at Ann Arbor, Michigan.
4. (116), discovered on September 8, by Dr. Peters, at Hamilton College, Clinton. This planet was independently discovered by Dr. R. Luther, on September 14.
5. *Lomia* (117), discovered on September 12, by M. Borelly, at Marseilles.

Six comets have been visible during the past year. Two of them, Encke's and Tuttle's, were expected to return to perihelion in 1871, but the remaining four appear never to have been observed before.

1. Comet I. 1871, discovered on April 7, by Dr. Winnecke, at Carlsrushe.
2. Comet II. 1871, discovered on June 14, by M. Tempel, at Milan.
3. Comet III. 1871 (Periodic Comet of Encke), first observed on October 4, by Dr. Dunér, at Lund. This Comet was first seen in England on October 8, by Mr. Hind.
4. Comet IV. 1871 (Periodic Comet of Tuttle), first observed on October 12, by M. Borelly, at Marseilles. Dr. Winnecke detected it on October 14.
5. Comet V. 1871, discovered on November 3, by M. Tempel, at Milan.
6. Comet VI. 1871, discovered on December 29, by M. Tempel, at Milan.

Encke's comet has been examined with large telescopes. At first it was a round faint nebulosity, but by the beginning of November the remarkable fan-like form which has distinguished this appearance of the comet was well marked. A minute stellar nucleus was situated at the eastern point of the fan. On the other side, towards the Sun, which the comet was approaching, the cometary matter was spread out until it was lost to view from faintness. During November the cometary matter on the side from the Sun seemed arrested a short distance behind the apex of the fan where its boundary was seen as a right line perpendicular to the longer axis of the fan-like form. Early in December a faint beam was seen to be projected from this side forming a true tail.

The Report next referred to the operations for ascertaining the variation of gravity in Western Russia, as detailed by M. Sawitsch, the publication of Mr. Williams's Catalogue of comets observed in China, Dr. Gould's observations of the magnitudes of stars in the southern hemisphere, and the progress of M. Delaunay's Lunar Tables.

The observations with the water telescope at Greenwich were mentioned—the object of which was to ascertain whether the constant of aberration would be altered by the light passing through a refracting medium. Professor Klinkerfues found such a result experimentally, but as the latitude of Greenwich, with this instrument, from γ Draconis, is found to be identical in spring and autumn, when aberration is greatest, whereas the difference, according to Klinkerfues, should be 30″, his conclusions are not supported by the result.

The scintillation of the stars by Professor Respighi of Rome, Mr. Proctor's important communications on the distribution of the fixed stars in space, and the motion of matter projected from the sun; Messrs. De la Rue, Stewart and Löwey on the laws of the frequency of sunspots; the supposed changes in the Great Nebula surrounding η Argus; Mr. Hind's list of total eclipses of the sun up to 1890; the proposed correction of Tables of Jupiter's satellites; M. Nyren's determination of the constant of precession; Professor Trettenero's catalogue of stars; the Pulkowa observations; the chronographic determinations of the differences of longitude between Cambridge, U.S. and San Francisco, the Righi-kulm, Neuchatel, and Zurich, Naples, and Rome; the preparations for the transit of Venus; the great Melbourne telescope, and Sir J. Herschel's history of double stars, were among the other subjects mentioned in the Report, to which, however, when published, we must refer our readers for further details, as the space at our disposal is necessarily limited.

We may, however, mention that the longitude of San Francisco, as determined in four ways, viz., directly, and with two intermediate stations, differently combined, agreed within three hundredths of a second of time, and that the time occupied in transmission of the signals over 7,200 miles was eight tenths of a second.

The President's Address.

Mr. Lassell said that, as already stated, the gold medal had been awarded to Sig. Schiaparelli for his researches on the connection between the orbits of comets and meteors. It was much to be regretted that the recipient could not be present, being detained by his work at home. He (the President) would notice first, that the medallist originally became known as the discoverer of the minor planet Hesperia, in 1861; his account of which showed that he possessed both modesty and practical skill. In 1864, he communicated to the *Astronomische Nachrichten* a mathematical paper on the orbits of bodies moving freely in space, which was elegant, and probably original. In 1866, the immediate subject of the address was broached by Schiaparelli in a series of letters to Secchi. He began with the August meteors, and showed that a large number of these had a common radiant point, and that these were all of a fine yellow colour. Others of different tints were less constant in the direction from which they started. He suggested that these meteors travelled in rings round the sun, and that the earth's orbit traversed these paths, and he propounded the enquiry how such masses of cosmical matter came to be accumulated in such places. He considered both planetary and cometic bodies, the latter having such extraordinary length of orbit that they seem as if picked up by the sun. Such bodies might become visible, either by the sun crossing their paths, or travelling parallel to them. In his second letter to Secchi, he illustrated his reasoning by a series of diagrams. He stated that celestial matter might be divided into fixed stars, collections of stars (resolvable nebula) and comets, which were cloudy bodies or dust clouds—a stream of this sort crossing the orbit of a planet would take the form of a cylinder, and, when close, might break up. Meteors were formerly thought to be connected with the earth, but should now be looked upon as of the same class as stars. The elements found in aerolites were some of those in the earth. In another paper sent to the *Astronomische Nachrichten,* Sig. Schiaparelli refers to his letters on the analogy between comets and meteors, to which he is disposed to attach great importance; and assuming the August meteors to move in a curve, seen in section, he gives the elements of such an orbit, and compares them with the elements of Comet III, 1862, as calculated by Oppolzer, and points out the remarkable coincidence between them. The period of the August meteors is somewhat doubtful, but Schiaparelli puts it at 105 years. He then took up the subject of the orbit of the November meteors, and adopting γ Leonis as the radiant point, and the other data from the display of 1866, finds the elements nearly coincident with those of the orbit of Comet I, 1866. We now know γ Leonis is not exactly the radiant point of the November meteors; and if the proper correction be made by using the point deduced from Alexander Herschel's observations, the difference between the two orbits disappears. The hypothesis, thus singularly confirmed in these two instances, must command a high degree of probability, and is a true advancement of Astronomical science, which, doubtless, Schiaparelli had not ventured to anticipate. His success should lead to arrangements for the systematic observation of these phenomena. The President then handed the medal to Col. Strange, requesting him to transmit it to Sig. Schiaparelli with the best wishes of the Society for a success in the future equal to that which he had already achieved, and that such might be continued during a long and prosperous life.

It was moved by Mr. Vignolles, seconded by Mr. Perigal, and resolved:

That the Report be received, printed, with the President's Address, and circulated in the usual manner.

Mr. C. V. Walker and Admiral Ommaney having been appointed Scrutineers, the ballot for the election of Officers took place. The result was as follows:

President:

Arthur Cayley, Esq., M.A., F.R.S., *Sadlerian Professor of Geometry, Cambridge.*

Vice-Presidents:

J. C. Adams, Esq., M.A., F.R.S., *Lowndean Professor of Astronomy, Cambridge.*
Warren De la Rue, Esq., D.C.L., F.R.S.
William Huggins, Esq., D.C.L., LL.D., F.R.S.
William Lassell, Esq., F.R.S.

Treasurer:

Samuel Charles Whitbread, Esq., F.R.S.

Secretaries:

Edwin Dunkin, Esq.
Richard A. Proctor, Esq., B.A.

Foreign Secretary:

Lieut.-Col. Alexander Strange, F.R.S.

Council:

G. B. Airy, Esq., C.B., LL.D., F.R.S., &c., *Astronomer Royal.*
John Browning, Esq,
J. Buckingham, Esq.
Thos. W. Burr, Esq.
W. H. Mahony Christie, Esq., M.A.
E. B. Denison, Esq., D.C.L., Q.C.
George Knott, Esq.
J. Norman Lockyer, Esq., F.R.S.
Rev. Robert Main, M.A., F.R.S. *Radcliffe Observer.*
Captain William Noble.
Rev. Charles Pritchard, M.A., F.R.S., *Savilian Professor of Astronomy, Oxford.*
A. Cowper Ranyard, Esq., M.A.

Upon the motion of Dr. Pinches, seconded by Admiral Ommaney, the thanks of the Society were voted to the retiring officers, and the Meeting adjourned.

Erratum in last Report. The foot-note at page 31 was omitted. It is—* Query *coronal.* The word *chromospheric* was used at the Meeting, but reference to Col. Tennant's letter shows that the radiation spoken of applied to the corona.

AURORA BOREALIS.

There was a magnificent display of aurora borealis on Sunday night, Feb. 4. It began about 6·30, and lasted for several hours. There was an intense red light passing across the heavens, through the constellation of the Great Bear, over the Pole Star, and so on, through the centre of Cassiopeia, and the most perfect cupola of light rays, culminating in Auriga, rather below Capella. Towards the close beautiful red rays shot through the region of Polaris to Auriga. It was observed at Constantinople and Alexandria.

AURORA OF FEB. 4, AT FLORENCE.

Professor Donati, in the *Gazette d'Italia,* of the 6th of February, writes that any description would only give a faint idea of the reality. . . . such was the abundance and beauty of the perpetual variations of aspect presented by the stupendous phenomenon. It began at 6 o'clock, with a *blood red* light on the N.E. horizon, which gradually spread, and rose higher. At 6h. 20m. it embraced an arch of 160 deg. on the horizon, and rose as far as the pole. . . . From that time till the end, so many were the rays at one time red, at another greenish, and at another yellowish, which rapidly changed their places, that a full description would be very complicated. At 9 h. a large red luminous arch extended from S.E. to S.W., having an elevation of 45° at the south. It might rather have been termed an aurora australis than borealis. . . . This arch disappeared at 9¼ h.; at 11 h. 40 m. the phenomenon was quite ended.

The magnetic needle, which had manifested perturbations ever since the morning, during the time of the aurora became quite wild (*affato impazzito*), and it was impossible to determine its position, since it had altogether left the graduated scale by which its direction is noted.

Great disturbances were manifested on the telegraph lines to Livorno, Bologna, and Turin, the electric currents continually changing in intensity and direction; but these changes were not contemporaneous nor analogous in the different lines. . . . The aurora is known to have been observed throughout all Italy, and as far as Malta. . . . I was fortunate enough to be enabled to analyse the spectrum of the auroral light . . . continuous from the red to the violet, but faint; nevertheless, it had a vivid light line in the green, which my observations showed to correspond with the middle of the space comprised between the lines *b*, *D*, of the solar spectrum. At intervals I also perceived a line in the red corresponding to about the line C of the sun; and one in the blue, corresponding to the solar line F; but their fleeting character prevented my determining their precise position.

The Professor then mentions some observations on the 4th and 5th which he made, but under unfavourable circumstances, on the disc of the sun, with a spectroscope applied to a small telescope. On the latter morning he noticed that the stratum of hydrogen was especially very high in the direction of the earth's equator. The spots on the sun, he observes, are at present very numerous; to-day we have counted 96. I made these observations on the solar disc as well as I could under the actual state of our observatory, which at this moment is neither in Florence, nor at Arcetic, but in a transitional state. . . . Much has yet to be done in this department of Natural Philosophy. . . . What, for example, is the bright green line which has been seen in the auroral spectrum? . . . It does not appear to correspond with any of the lines that we can produce with any terrestrial substances. It is held (and for many good reasons) that the auroral lights arise from weak and continuous electric discharges. But if the light of the aurora is electric, it should have the same lines which are observed whenever with our laboratory apparatus we cause the electric light to pass through the air; but it is not so; and, in fact, the green line of the aurora has never even been seen in our experiments. Anticipating the hereafter clearing up by science and art of this and many other mysteries, Donati observes that, in order to uninterrupted advance, much intellectual strength is needed, and likewise much material strength, since now progress in Physics cannot be made if the most elevated genius is without the aid of apparatus, perfect, exquisite, and always very costly.

The Contessa Baldelli, observing that "Nothing could describe the loveliness and grandeur of the sight," says: "Donati does not appear to have seen an extraordinary appearance. Baldelli and myself (and I hear another person of my acquaintance also) saw, just about Lepus, below Orion, several curved and parallel waves of *very* bright white light moved towards each other; met, broke; met once more; separated again in different forms; flashed brighter, just into what had the appearance of white flame; darted about like white lightning, and ended by making a crown of irregular rays (quite fiery), some very long; and then, after a second or two (the whole appearance lasting not quite two minutes, I should think) disappeared all at once. I think the time was 8·30 P.M."

AURORA OF FEB. 4, AT FLORENCE.

Yesterday, we passed from one spectacle to another. The heavens, too, willed to celebrate a festival, and to salute, with their Bengal lights, the resuscitated carnival; presenting us with the most brilliant, the most splendid aurora that has been ever seen.

The people, who were quietly returning from the Corso to dinner, were at first surprised at the sight of that unwonted reddish colour, which looked like the reflection of a fire, and then presented the appearance of clouds, reddened by a gradual sunset. But as the air became darker, those transparent clouds began to dilate themselves, spreading over the heavens like an immense purple sheet, perforated here and there, or like a thin veil, through which the stars, tinged with red, were seen to twinkle. And then the people, unmindful of dinner, stopped curiously in the streets, formed groups in the piazza, and with eyes turned upwards, and endless exclamations of wonder, followed the singular phenomenon in all its fantastic course.

No one remembers in our climes anything similar; no one can speak of having seen an aurora which lasted from half-past five or six o'clock till towards midnight.

It was an imposing and a grand sight, at once awe-inspiring and fascinating. Everyone could have wished to possess such knowledge of astronomy as to account for the different phases, the capricious undulations, the wanderings, the transformations of the ætherial mass waving in the atmosphere, that drifted as though impelled by the night breeze, and in its movement took ever new forms, lengthened itself in luminous bands, and arranged itself like so many rays converging to a centre.

Perhaps the finest moment was between half-past six and seven, when on the north, behind the Mount of Fiesole, was to be seen clear and most distinct the limpid and tranquil light of the aurora, with a lustre so white as to make one fancy that the sun was there just on the point of rising.

The mountain all round received the quiet splendours of the nascent dawn; the little hills were illumined, standing out distinctly, and not as before obscure in the horizon. Nevertheless, there was something in that distant light, something that convinced one that it was the reflection of an aurora rather than a real day-spring.

The mountain appeared somewhat depressed; the light did not send forth those gradations of colour which announce the rapid approach of day; it remained there, motionless, limpid, and cold, as though our eyes also were struck by the reflection of eternal and immovable polar ice. And all round it there was, as it were, a garland of little clouds, which reflected and sent back the brightness, and from thence parted off long luminous bands suffused with mist, which, as they approached the fiery mass on the other part of the heavens, gradually acquired a deeper tint till they assumed altogether the colour of fire, and were lost in that aerial torrent which resembled lava poured forth from some celestial volcano, and kept by a mysterious force suspended and waving in the air.

The crowd of curious persons did not decrease in any quarter of the city, for the spectacle altered every moment, assuming new and fantastic shapes. For instance, about nine o'clock, on the Lungarno the red curtain was seen rent in some places, and then, in place of the blue vault of heaven, there appeared there what resembled three or four tails of comets, curiously twisted and knotted together like a gigantic white plume.

These tails then suddenly changed colour and became empurpled, like thousands of the plumes of carabineers on a gala day; and on all sides there were sparkling bands and luminous paths like ribbons, and parallel lines which were lost as they became curved on the vault of the heavens, and gave the idea of an aerial double line of railroad, and rays and beams, and glowing mists, and fresh rents, and fresh forms, and a crowding together, and a dissolution—in a word, a spectacle most marvellous and of infinite delight.

I have thus recalled the passing impressions of the most remarkable evening which we, whom Nature rarely favours with extraordinary sights have ever seen. But science is entitled to give her account. . . . . (The writer goes on to refer to Professor Donati's letter on the aurora, and then observes.) When the theatres were closed last night, and everyone returning home was gazing upon the horizon, the aurora was quite over, and in one of the places where it had been most vivid, there were to be seen some clouds of curious forms, detached from each other, and motionless in the sky, like the tents of an encampment after a whole day's battle. Editorial article in the *Gazzetta d'Italia*, Florence, Feb. 6, 1872.

THE TOTAL SOLAR ECLIPSE OF 1871.

LETTER FROM M. JANSSEN TO MR. LASSELL, P.R.A.S.

(Translation.)

I shall have the honour of addressing to the Royal Astronomical Society a detailed account of my Observations of the Eclipse; but I take the opportunity of the post leaving to inform you of the principal results obtained.

Without going into a discussion, which will form part of my report, I will first say, that the magnificent corona observed at Sholoor was exhibited under such an aspect that it would appear to me impossible to admit that the cause of the phenomena was of the order of either diffraction, reflection from the lunar surface, or even of simple illumination of the terrestrial atmosphere.

The reasons which militate in favour of an objective, circumsolar cause acquire invincible force when we examine the luminous elements of the phenomena. Indeed, the spectrum of the corona appeared in my telescope not continuous, as it had been described up to this time, but remarkably complex. I have found in it:—

Bright lines which, although faint, are those of hydrogen gas, which constitutes the principal element of the prominences and chromosphere. The bright green line, which has already been noticed in 1869 and 1870, and some other fainter lines, also some dark lines of the ordinary solar spectrum, especially that of Sodium (D). These are very difficult to perceive.

These facts prove the existence of matter in the vicinity of the sun, matter which shows itself in total eclipses by the phenomena of emission, absorption, and polarization.

But the discussion of these facts leads us much further still.

Besides the cosmical matter, independent of the sun, which must exist in the neighbourhood of this star, the observations demonstrate the existence of an extended and excessively rare atmosphere, with a basis of hydrogen, stretching itself out beyond the chromosphere and the prominences, and feeding itself with the same matter as these bodies—matter shot out with great violence from the photosphere, as we see daily.

The rarity of this atmosphere must be excessive; its existence, therefore, is not discordant with the observations of some passages of comets near the sun.

Neilgherry, Sholoor: December 19, 1781.

THE GREAT MELBOURNE TELESCOPE.

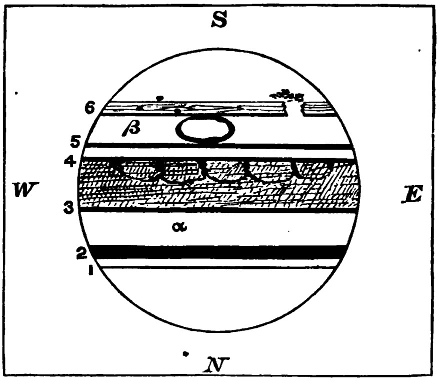
We find by the report of the board of visitors to the Observatory of Victoria that the great telescope is working well. Mirror A, which was so much tarnished, has been repolished, and its " performance has been found to be working very satisfactorily." It is also noticed that the cause of the defect in mirror B has been discovered, and that a remedy can be found for it. Further experience of the telescope has much enhanced the observers' opinion of it.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

JUPITER.



From 6 p.m. to midnight on the 2nd of February, the sky was cloudless; and, though the definition was never good, a set of five careful drawings was obtained here.

I proceed to describe these in the order in which they were taken :—

No. 1, at 7 p.m. Band No. 3 is as broad and dark as No. 2. No. 4 is faint, and has dark spots under it.

The new band (between Nos. 2 and 3) is faintly seen. *All the bands are faint.*

The shading about the N. pole is much darker than that about the opposite pole. It is also more extensive, but no bands are seen in it.

Not far from the E. edge No. 5 is seen to touch No 4 ; it then slopes to the S.W. at an angle of some 30°, and then bifurcates ; one portion runs to the west, parallel to No. 4, and the other continues in the original direction, until it reaches the latitude of No. 6. The sloping branch is a broad streak; the other is faint, and has two faint dark spots upon it. This sloping band it well shown in Mr. Birmingham's neat sketch. To the east, No. 6 is seen as a dark very broad cloudlike mass.

No. 2 at 6h. 30m. p.m.

No. 2 is now broader and darker than 3 or 4.

No. 6 is the broadest, and is as dark as No. 2. Its width is about 2″.

The brightest zone is that lying between No. 2 and the south edge of the shading about the N. pole.

The zone between 2 and 3 is dusky, and the new band can be traced along it from edge to edge of the disc.

A narrow band is well seen just south of No. 6.

The sloping portion of No. 5 is still seen; it falls down quite to No. 4; it reappears towards the east as a narrow band parallel to No. 4.

No. 6 is the finest streak visible. It is connected with No. 5 by two faint cloudy patches.

In the central zone are seen the usual dark spots under No. 4, and the usual cloudy markings in some portions. Along the central line runs a narrow band; before reaching the eastern limb it bends down to No. 3; the space between this central band and No. 3 is free from colour and markings.

The other parts of the great equatorial zone are reddish, but the colour is best seen in the northern parts.

No. 3, at 9h. 30m. p.m.

The fine southern band No. 6 is now passing away, growing gradually narrower towards its eastern extremity.

No. 5 is visible only near the E. limb.

Under No. 4 two bright rectangular spaces are now seen, each is about 4″ in length; a similar one lies on No. 3, below and between those on No. 4.

The latter quite cuts through the band.

The new band between Nos. 2 and 3 is seen from limb to limb.

No. 4, at 10h. 30m.

No. 2 is now the finest streak on the disc.

Three bright rectangular spaces lie on No. 3, and five or six similar spaces are seen under No. 4.

No. 5 is remarkably developed; it is very broad near the E. and W. limbs of the planet, but its middle portion is narrower.

No. 6 is seen near the western edge of the disc; it then turns south-eastwards and runs gradually up to the shading about the southern pole; it is again seen in the original parallel near the E. edge of the disc.

The zone between Nos. 2 and 3 is very dusky, but has one large bright space near the centre.

No. 5, at 11h. 45m.

The shading about the *south pole* is now darker than that about the opposite pole. Its northern edge has a bright square gap cut out of it, greatly resembling that so often seen in 1869.

No. 6 is faint, and a still fainter streak is seen to the south of it.

No. 5 is broader and darker and varies considerably in width and darkness in different parts.

It is now quite impossible to distinguish clearly the boundary between the central zone and the zone between bands 2 and 3, so nearly identical are they in appearance, *i.e.*, band No. 3 is perhaps quite invisible; the shady region, therefore, extends from 2 to 4 and gives the disc a very strange appearance. A row of bright spaces lies under No. 4, one is also seen where band No. 3 used to be, and not far from the west edge of the disc.

No trace of a reddish hue can now be seen in the central zone.

Mr. E. Crossley's Observatory, JOSEPH GLEDHILL,
Park Road, Halifax : F.G.S., &c.
Feb. 5, 1872.

THE TAIL OF ENCKE'S COMET AND THE SECONDARY LIGHT OF VENUS.

Sir,—In reference to Mr. Knobel's letter in your last impression on Encke's comet, having been hitherto supposed to be destitute of a true tail opposite to the sun, may I direct his attention to the following observations made at the appearance of 1848.

Professor W. C. Bond, of Cambridge, U.S., made the following notes (amongst others), which are printed in the *Monthly Notices*, Vol. IX., p. 107: "October 27: a faint ray of light is now seen directed from the sun. November 3: the Comet shows a tail of one or two degrees, directed *from* the sun; with the same appearance on the opposite as in October" (*i.e.*, a fan-shaped brush of light on the side *towards* the sun).

Dr. Julius Schmidt, observing at Bonn on the same occasion, speaks also of seeing traces of a tail on the 22nd of October and 9th of November. *Astronomische Nachrichten*, Vol. XXVIII., p. 186. The same well-known and now veteran astronomer made also a valuable series of observations of Encke's Comet at the appearance in 1868, and says: (*Astronomische Nachrichten*, Vol. LXXII., p. 323) "that from August 20 to 29 the tail was quite narrow, very faint, straight, and in the normal position" (*i.e.*, opposite to the sun).

In reference to my own letter on Dr. Winnecke's observation of the secondary light of Venus, at her last inferior conjunction, I beg to inform you that I have been favoured by a letter from Mr. C. Leeson Prince, of Uckfield, in which he calls my attention to some observations of his own, printed in the *Monthly Notices*, Vol. XXIV., p. 25. It is there recorded that on the 25th of September, in the year 1863, Mr. Prince saw the dark body of Venus in the day-time; also on the 26th and 28th (the latter being the day of inferior conjunction); and that on the 25th, 27th, and 30th, he saw a phosphorescent flitting of light all round the edge of the disc. Dr. Winnecke appears therefore to have been in error in supposing that Andreas Mayer had been the only previous observer of the secondary light of Venus in the day-time.

I remain, sir, yours faithfully,
Blackheath; January 8, 1872. W. T. LYNN.

EPSILON LYRÆ.

Sir,—I have read with very great pleasure and interest the able letters of Mr. Grover and your esteemed correspondent, Mr. Squire, referring to the minute stars near Epsilon Lyræ. It would appear that neither of these observers have yet picked up the new pair, No. 4; I am rather surprised at this, as (unless they have since decreased in brilliancy) they ought to be seen pretty readily. This pair is not situate *between* the quadruple and the triangular figure preceding them, but just to the north of the northernmost of pair No. 3. The new pair forms almost an exact fac-simile of the "Debilissima," being at the same angle and distance apart, but are somewhat brighter.

As this subject is an interesting one, and both Mr. Grover and Mr. Squire have referred to evidences of *variability* in some of these faint objects, it may not be uninteresting to your correspondents to know that there is also distinct evidence of variability on the lustre of the N star of pair No. 3. I call these pairs numerically only because no better method of recognising them is yet given. In January, 1871, I found the order of brilliancy of these objects to be, as I stated in my letter of February, viz.:

Pair... ...	No. 1.	No. 2.	No. 3.	No. 4.
N. star ...	6	×	2	3
S. star ...	5	7	×	4

the 9th magnitude star following, being called 1. At this time, the northernmost of pair No. 3 was a very easy object, being nearly as bright as 1. The new pair No. 4, just to the north of it, were far more difficult to see, being nearly 1 magnitude less than their neighbour. In September, 1871, I was surprised to observe that considerable changes had taken place. Pair No. 4 were seen pretty easily, but the one to the south of them (being the N. of pair 3), instead of being, as usual, *brighter* than pair No. 4, was much *less bright* than those, and could only be *glimpsed with averted vision.* A comparison of the brilliancy of pair 4, with the 9th magnitude star following, showed them to be of the usual brightness, thus proving that the N. of pair 3 had really decreased considerably in lustre. I should estimate the decrease to amount to nearly 2 m. These facts, combined with the almost certain variability of one of the "Debilissima" lend additional interest to the group.

A reference to my note book informs me that I first noticed the great increase in the lustre of the N. of pair 3, on May 25, 1870, not having remarked it previously, although the object had often been under observation. Its large decrease was first noticed on September 25, 1871; whether it had attained a minimum within this period I cannot, of course, say for certain. I trust both Mr. Grover and Mr. Squire will kindly favour us with the result of their further observations of the group.

May I take the opportunity of respectfully thanking your talented contributor, Mr. Gledhill, for his courteous reply to my query on Jupiter. As no other observer seems to have recorded anything on the date in question, we must conclude that the weather was unfavourable in most localities. I regret this, as the observation would have been valuable, if corroborated by others. I remain, yours faithfully,

Hoxton Street, N. ALBERT P. HOLDEN.
January 6, 1872.

CUI BONO.

Sir,—Presuming your *Register* is published for the edification of the ignorant as well as the amusement of the learned, I may be pardoned in making exception to "A Subscriber's" comparative analysis of Mr. Waite's and Mrs. Nickleby's respective form of expressions.

For my own part, I am better able to appreciate Mr. Waite's meaning when he compares the size of a possible planet to "an ordinary sized marble," than I am to understand the capabilities of Mr. Abbott's telescopes, showing "a field of 1° 7' 42"," and, I am ashamed to confess, that I have more faith in the record of a fact that happened between the years A.D. 1860 and 1863, than in the theory that Mr. Williams supports, that a conjunction of the five principal planets occurred during the reign of Chuen Kuh, on the 29th Sept., B.C. 2449.

Taking much interest in the little I am able to understand in your publication, I trust, in opposition to "A Subscriber's" title, to demand that such records referred to should be excised, that you will be pleased at times to lower your ideas and communications to the level of—

January 10, 1872. Yours obediently, R. E. J.

DYNAMETER OR DYNAMOMETER.

Sir,—I know not if it be worth while to discuss further the "Dynamometer" question. As rightly observed by yourself, "Dynameter" (honour all the same to Jesse Ramsden) cannot pass muster if judged by ordinary rules of composition, which is a pity, for it is a handier word than the other.

As Mr. Williams shows, it is not so much a question of spelling as usage; and whilst we have so much that is arbitrary and merely conventional in our language, one is disposed to attach the less importance to any one particular instance.

I am not aware, however, if you have noticed that neither is "dynamometer" formed according to strict analogy. Suppose we had to coin a word fresh for our purpose. With the conjunctive vowel *o* would it not properly be *Dynami-o-meter* (dynamiometer)? This would accord with *Physi-o-logy* and *Ichthy-o-saurus.* Or, without the conjunction vowel, we might have *Dynamimeter.* "Dynamometer" may, indeed, be supposed to be made up of the conjunction *o*, blended with the long *o* of the *Attic* genitive; thus, *Dynameōmeter,* and the final process (perhaps a venial license) would give us the contracted (?) form in which the word is now used. Ordinary pronunciation is probably against this theory, the *o* being sounded as in barometer. I don't see how it can be accounted for. It was not really required at all, and ought not to have displaced the *i.* Anyhow, there it is, and the French, I think, use the same word, dynamomêtre. Yours, &c., G. J. W.

Dear Sir,—I must trouble you to correct a serious printer's error in my letter in your January number. In page 17, line 40, the word *dynameter* should be *dynamometer*, as you will find on referring to my MS.

Your note appended to my letter requires a few lines in reply. I by no means admit that "dynameter means nothing at all." *Dyna* does not, it is true, contain as many syllables as *δυναμις*; but whether the retrenchment of a syllable by the ordinary and perfectly legitimate operation of syncope renders the word meaningless, or whether the introduction of a wrong syllable (by which the word is not only unnecessarily lengthened but made less euphonious) converts it into an intelligible expression, I leave to your readers to decide. In my opinion a better or a neater word than *dynameter* could not have been framed; and I venture to contend, with great submission, that there is no foundation for your statement that *dynamometer* is the only admissible one. In the case you have suggested it is quite clear that "chrometer" would never have sufficed to describe an instrument for measuring time, because it would not have reasonably resembled its first derivative. "The Comprehensive Dictionary" gives the verb *μετρεω* as one of the derivatives of dynameter, and until satisfied that that authority is untrustworthy I shall be disposed to rely upon it. Numerous similar instances occur in the same work; telescope, for example, is said, and properly said, to be derived from *τηλε*, or *τηλος* and *σκοπεω*. The fact that the Greeks observed certain rules in the formation of their compounds in no way affects the present question, seeing that the word dynameter was not invented by the Greeks but by the English. Yours faithfully,

Upper Holloway: GEO. WILLIAMS.
Jan. 12, 1872.

[We owe some apology to our readers for giving so much of our space for a subject not properly astronomical. We should not have done so except that we felt the importance of once for all protesting against the crude and unscholarlike way in which scientific words are so frequently formed. We never doubted that the instrument in question had been called a dynameter. What we meant was that it should never have been so named, and now that the word was more commonly spoken of as a dynamometer; that that form of the word, being correctly compounded, was preferable to the curtailed form.

There is no rule of syncope known to the Greeks by which *δυναμομετρον* could be contracted into *δυναμετρον*. There is no sense in the word *δυνη* or *δυνα*, and so none in *δυναμετρον*. Mr. Williams objects to our comparing the word with chronometer—chrometer. Be it so. Take the word anemometer, and we have a word letter for letter similar to dynamometer. If his "ordinary" (?) rule for syncopation be corrrct, and two instruments of measure were required, we might say "anemeter," which would really give no sense at all, any more than dynameter does. The most learned Greek scholar could only *guess* at what either word meant.

With respect to Greek compounds, I refer our correspondent to Dr. Jelf's Greek Grammar, § 346, Obser. 1. b. How much ignorance existed with respect to this matter was shown by Professor Shillito when the word telegram was first coined. If any of the words spoken of were derived from the verb, they would have a verbal form. Thus, telegram would be telegrapheme ; dynamometer would be dynamometrem (*μετρημα*) or dynamometrete (*μετρητης*).

If Englishmen derive scientific words from Greek, they ought to conform to the Greek usage of composition. If this were done, our language would not be deformed by such monstrosities as pannus corium, and half the botanical and other scientific words which are a disgrace to us, among which I must class dynameter.

Mr. Walker's objection "solvitur ambulando," as it were, for there is a Greek word extant, *δυναμοδυναμις* (a biquadratic root) to guide us, so that there need be no hesitation in using dynamometer.

SPECTRUM ANALYSIS.

No book has been published in England more likely to popularise the very interesting subject of Spectrum Analysis, than the Miss Lassell's admirable translation of Dr. H. Scheller's valuable work, published by Messrs. Longmans, Green and Co.

The book was recommended to these ladies by Dr. Huggins, as the best elementary book upon the spectroscope ; and, fortunately, they were so interested that they determined to publish an English Edition. All who wish to commence the study of the spectroscope, which is playing so prominent a part in Science, should read this volume, which gives a most lucid and complete explanation of the instruments which have been used for the purpose, and of the discoveries made up to the present time. In a subject so comparatively new, of course some of the theories are to be received with caution, and much that is now thought to be proved, will doubtless have to be reconsidered. With this proviso, we can thoroughly recommend the book, which is sumptuously got up and profusely illustrated. Of course, some of the most interesting pictures are those of the various views of the sun at the total eclipses, and the solar prominences which have of late years attracted such attention.

We have no doubt that the work will have the large circulation which it well deserves.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MARCH, 1872.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ⊙ Midnight.	Objects to be observed.
	° ′	
13	124 32·1	Hagecius, Picard, Reichenbach.
14	113 8·4	Democritus, Sartner, Fermat.
15	102 1·2	Clairaut, Cuvier, Descartes.
16	91 5·7	Eudoxus, Aristoteles, Alexander (*a*).
17*	80 16·1	Mt. Huygens, Kirch, La Caille.

18	...	69 27·1	...	Gambart, Heinsius, Hesiod.
19	...	58 33·5	...	Kies, Lubiniezky, Stadius.
20	...	47 30·7	...	La Hire, Pytheas, Gay Lussac.
21	...	36 15·0	...	Rosh Gassendi, its interior.
22	...	24 44·0	...	Piazzi, Grimaldi, Pythagoras.
23	...	12 56·5	...	La grange, objects near E. limb.

For additional objects consult the lists for November and January.

Season.—Winter in the northern hemisphere. The solstice occurred on the 7.

Between new moon and the 13th the following objects constituting a zone from north to south may be observed as they come into sunlight. They with the previous zones (see January and February) have been arranged to assist the observer in picking up objects during the progress of the terminator, and will help in approximately forming zones of latitude, if arranged somewhat as follows from each zone.

Mare Humboldtianum, Endymion, etc.; Plutarch, Oriani, Eimmart, etc.

Webb's map will greatly assist in effecting these arrangements. Advantage should be taken when the moon is between Perigee and Apogee for observing these objects,

Thales, Strabo, De la Rue, Endymion, Struve, Eimmart, Alhazen, Hansen, Maclaurin, Palitzsch, Hase, Vega.

* Plato.—On the 17th, the terminator will be near Plato. On the 18th of January, 1872, the phase of illumination (terminator through the W. part of Plato) was nearly the same as on March 10 and May 8, 1870. On May 8, 1870. ⊙—☊ = 295° 31′, on March 17, 1872, ⊙—☊ = 280° 34′. The seasons being so much alike in both cases, it is probable that on March 17, 1872, the western edge of Plato will be just in sunlight. (*a*) See February 25, 1871.

Errata.

Page 45, February 12, for *Sautbech* read *Santbech*, February 18, for *Delue* read *Deluc*. In last line but two, for *Pitavius* read *Petavius*. Page 46, line 2, for *Lapeycourse* read *Lapeyrouse*.

February 14 and 15. The objects entered against those days in the last list were *not* in sun-light, but were well illuminated on the following days. This was occasioned by the great eastern libration. The moon being between Perigee and Apogee, these objects were beyond the terminator, as referred to the phases. At midnight, on the 15th, six hours before First Quarter, the longitude of terminator was quoted as 8°4 west, at 6h. it had scarcely advanced beyond 15°.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, Midnight			60°N.		0°		60° S.
				Sunset.			
1872. Feb.	1	...	+ 3°·5	...	+ 6°·1	...	+ 8°·8
	2	...	− 8·7	...	− 6·1	...	− 3·4
	—						
	3	...	20·9	...	18·2	...	15·6
	4	...	33·1	...	30·4	...	27·8
	5	...	−45·3	...	−42·6	...	−39·9
				Sunrise.			
	11	...	+66·8	...	+64·1	...	+61·5
	12	...	54·6	...	51·9	...	49·3
	13	...	42·4	...	39·7	...	37·1
	14	...	30·2	...	27·5	...	24·9

15	—	18·0	...	15·3	...	12·7
16	...	+ 5·8	...	+ 3·2	...	+ 0·5
—						
17	...	— 6·4	...	— 9·0	...	—11·6
18	...	18·6	...	21·2	...	23·8
19	...	30·8	...	33·4	...	36·0
20	...	43·0	...	45·5	...	48·1
21	...	55·1	...	57·7	...	60·3
22	...	67·3	...	69·9	...	72·4
23	...	—79·5	...	—82·0	...	—84·6
—						

SUNSET.

25	...	+71·2	...	+73·7	...	+76·2
26	...	59·0	...	61·5	...	64·0
27	...	46·9	...	49·4	...	51·8
28	...	34·7	...	37·2	...	39·6
29	...	22·6	...	25·0	...	27·4
30	...	+10·4	...	12·8	...	15·2
31	...	— 1·8	...	+ 0·6	...	+ 3·0

The sun's disc passes the true horizon of Linné—

On March 15 from 20h. 5m. to 21h. 7m. rising.
„ 30 „ 12h. 4m. to 13h. 6m. setting.

THE PLANETS FOR MARCH.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	22 30 13	—11 39½	4″·8	23 47·9
	15th	0 0 47	—0 60	5″·0	0 27·1
Venus ...	1st	20 40 40	—18 24	13″·0	21 58·7
	15th	21 49 22	—13 37½	12″·2	22 12·2
Jupiter ...	1st	7 27 35	+22 26	40″·4	8 47·8
	15th	7 26 16	+22 29½	39″·8	7 51·4
Saturn ...	15th	19 24 57	—21 40½	14″·4	19 55·4
Uranus ...	1st	7 59 20	+21 17	4″·2	9 19·4
	13th	7 58 9	+21 16½	4″·2	8 31·1

Mercury is favourably situated for observation at the end of the month, setting on the last day an hour and three quarters after the sun; he comes to superior conjunction on the evening of the 10th, at 9h. 3m.

Venus rises nearer to the sun each day, the interval decreasing at the end of the month to half-an-hour.

Jupiter is still visible all night, aud very favourably situated for observation.

Uranus is well situated for observation.

ASTRONOMICAL OCCURRENCES FOR MARCH, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m s.	h. m. Jupiter
Fri	1		Sidereal Time at Mean Noon, 22h. 38m. 23·10s.	1st Oc. D. 1st Ec. R.	8 28 11 45 2	8 47·8
Sat	2	7 28 16 54 18 7 17 7 18 5	☾ Moon's last quarter Occultation of B.A.C. 5831 (6) Reappearance of ditto Occultation of 39 Ophiuchi (6) Reappearance of ditto	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	5 47 6 48 8 7 9 8	8 43·6
Sun	3		Sun's Meridian Passage 12m. 1·62s. after Mean noon	1st Ec. R. 2nd Oc. D.	6 13 53 14 31	8 39·5
Mon	4	8 45 20 5	Conjunction of Venus and θ Capricorni (5m.9) E. Conjunction of Moon and Saturn 2° 58′ N.			8 35·5
Tues	5			2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E.	8 38 10 44 11 33 13 40	8 31·4
Wed	6	11 16	Conjunction of Moon and Venus 3° 58′ N.	4th Sh. I. 3rd Oc. D. 3rd Oc. R. 4th Sh. E. 3rd Ec. D.	7 48 8 16 11 44 12 9 12 38 12	8 27·3
Thur	7			2nd Ec. R. 1st Tr. I. 1st Sh. I. 1st Tr. E.	8 45 35 13 9 14 14 15 29	8 23·3
Fri	8	19 42	Conjunction of Moon and Mercury 3° 35′ N.	1st Oc. D. 1st Ec. R.	10 17 13 40 15	8 19·2
Sat	9	0 53	● New Moon	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	7 37 8 43 9 56 11 3	8 15·2
Sun	10	3 21	Conjunction of Moon and Mars 4° 34′ N.	3rd Sh. E. 1st Ec. R.	6 6 8 9 7	8 11·2
Mon	11					8 7·2
Tues	12			2nd Tr. I. 2nd Sh. I. 2nd Tr. E.	11 5 13 21 14 0	8 3·3
Wed	13			3rd Oc. D. 3rd Oc. R.	11 55 15 24	7 59·3
Thur	14			2nd Oc. D. 4th Oc. D. 4th Oc. R. 2nd Ec. R. 1st Tr. I.	6 10 6 46 10 56 11 21 23 15 0	7 55·3
Fri	15		Illuminated Portion of disc of Venus 0·849 „ Mars 0·992	1st Oc. D. 1st Ec. R.	12 8 15 35 33	7 51·4

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sat	16	14 25 8 16	☽ Moon's First Quarter Near approach of B.A.C. 1774 (6½)	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	9 27 16 38 11 47 12 58	Moon. — 5 49·1
Sun	17	 11 8 11 53	Saturn's Ring: Major Axis 36·15″ Minor Axis 14·29″ Occultation of B.A.C. 2154 (6½) Reappearance of ditto	3rd Sh. I. 1st Oc. D. 1st Ec. R. 3rd Sh. E.	6 33 6 36 10 4 26 10 7	6 38·7
Mon	18	12 32	Conjunction of Moon and Jupiter, 2° 18′ S. Sun's Meridian Passage, 8m. 4·28s. after Mean Noon	1st Tr. E. 1st Sh. E.	6 15 7 27	7 28·7
Tues	19	3 4	Conjunction of Moon and Uranus, 2° 46′ S.	2nd Tr. I.	13 35	8 18·3
Wed	20			3rd Oc. D.	15 40	9 7·0
Thur	21			2nd Oc. D. 2nd Ec. R.	8 39 13 57 5	9 54·4
Fri	22			1st Oc. D. 4th Tr. I.	14 0 14 16	10 40·5
Sat	23			2nd Sh. E. 1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	8 15 11 19 12 33 13 39 14 53	11 25·8
Sun	24	13 43 3 24	○ Full Moon Conjunction of Mars and Mercury, 1′ 8″ N.	1st Oc. D. 3rd Tr. E. 3rd Sh. I. 1st Ec. R. 3rd Sh. E.	8 28 9 3 10 32 11 59 50 14 6	12 10·8
Mon	25	16 8 16 39 17 9	Near Approach of 65 Virginis (6) Occultation of 66 Virginis (6) Reappearance of ditto	1st Sh. I. 1st Tr. E. 1st Sh. E.	7 2 8 7 9 22	Jupiter. — 7 12·8
Tues	26	13 8 14 11	Occultation of 96 Virginis (6½) Reappearance of ditto	1st Ec. R.	6 28 39	7 9·0
Wed	27	16 30 17 13	Occultation of γ¹ Libræ (6) Reappearance of ditto			7 5·2
Thur	28			2nd Oc. D.	11 9	7 1·4
Fri	29	13 5 13 27 13 37 14 11	Occultation of 22 Ophiuchi (6½) Reappearance of ditto Occultation of 24 Ophiuchi (6½) Reappearance of ditto			6 57·7
Sat	30			2nd Sh. I. 2nd Tr. E 2nd Sh. E. 1st Tr. I. 1st Sh. I.	7 55 8 18 10 51 13 12 14 28	6 53·9
Sun	31	14 31	☾ last quarter	3rd Tr. I. 1st Oc. D. 4th Ec. D. 3rd Tr. E.	9 25 10 21 11 54 3 12 54	6 50·2

SUN.

Greenwich, Noon.	Heliographical longitude of the centre of the sun's disc.		Heliographical latitude of the centre of the sun's disc.	Angle of position of the sun's axis.
1872.	°		°	°
Mar. 1	330·77	+60 δ ξ	−7·24	338·00
2	343·96		7·25	337·76
3	357·15		−7·25	337·52
4	10·34		7·25	337·29
5	23·53		7·25	337·07
6	36·72		7·24	336·85
7	49·91		7·24	336·64
8	63·10		7·23	336·46
9	76·30		7·22	336·24
10	89·49		−7·21	336·04
11	102·69	+70 δ ξ	7·19	335·85
12	115·88		7·17	335·68
13	129·08		7·15	335·51
14	142·28		7·13	335·35
15	155·47		7·11	335·19
16	168·67		7·08	335·04
17	181·87		−7·05	334·89
18	195·07		7·02	334·76
19	208·27		6·99	334·63
20	221·47		6·96	334·50
21	234·67	+80 δ ξ	6·92	334·39
22	247·87		6·88	334·28
23	261·08		6 84	334·18
24	274·28		−6·80	334·08
25	287·49		6·76	333·99
26	300·69		6·71	333·91
27	313·90		6·66	333·84
28	327·10		6·61	333·77
29	340·31		6·56	333·71
30	353·52		6·50	333·66
31	6·73	+90 δ ξ	−6·45	333·61

JUPITER.

G. M. T.	Zenographical longitude of the centre of ♃'s disc. 6h.	8h.	10h.	12h.	Angle of pos. of ♃'s axis. 12h.
1872.	°	°	°	°	°
Mar. 1	341	54	127	199	10·03
2	132	205	277	350	10·02
3	283	355	68	140	10·00
4	74	146	219	291	9·98
5	224	297	9	82	9·97
6	15	87	160	233	9·96
7	166	238	311	23	9·95
8	316	29	101	174	9·94
9	107	179	252	325	9·93

10	...	258	330	43	115	...	9·92
11	...	48	121	193	266	...	9·91
12	...	199	271	344	57	...	9·91
13	...	350	62	135	207	...	9·91
14	...	140	213	285	358	...	9·90
15	...	191	3	76	149	...	9·90
16	...	82	154	227	299	...	9·90
—							
17	...	232	305	17	90	...	9·91
18	...	23	95	168	240	...	9·91
19	...	173	246	318	31	...	9·92
20	...	324	37	109	182	...	9·92
21	...	115	187	200	332	...	9·93
22	...	265	338	50	123	...	9·94
23	...	56	128	201	274	...	9·95
—							
24	...	207	279	352	64	...	9·96
25	...	357	70	142	215	...	9·98
26	...	148	220	293	5	...	9·99
27	...	298	11	83	156	...	10·01
28	...	89	161	234	307	...	10·03
29	...	240	312	25	97	...	10·04
30	...	30	103	175	247	...	10·06
—							
31	...	181	253	326	38	...	10·08
April 1	...	331	44	116	189	...	10·11

Zenographical latitude 1°·0 North.

Zenographical longitudes and latitudes of the centres of the sketches of Jupiter, found in the *Astronomical Register*.

Sketches arranged in order of time.

	G. M. T.			long.		lat.	
1869.	h.	m.		°		°	
Oct. 6	9	30	...	110	—816x	+3·4	A 1
Nov. 1	7	55	...	15	—790x	+3·3	A 2
24	10	0	...	320	—767x	+3·3	A 3
25	10	50	...	141	—766x	+3·2	D 4
—	11	15	...	156	„	+3·2	D 3
30	12	15	...	226	—761x	+3·2	D 6
Dec. 21	11	10	...	112	—740x	+3·1	D 5
1870.							
Jan. 23	7		...	252	—707x	+3·0	D 2
—	8	20	...	301	„	„	B 6
25	5	35	...	142	—705x	+2·9	B 2
—	6	10	...	163	„	„	B 3
—	7		...	194	„	„	B 4
—	7	15	...	203	„	„	D 1
—	8	50	...	260	„	„	B 5
31	7	30	...	35	—699x	+2·9	B 1
Sept. 20	15		...	311	—467x	+2·6	C 4
24	12	30	...	103	—463x	+2·6	C 1
—	14		...	157	„	„	C 2
26	13	15	...	72	—461x	+2·6	C 3
Oct. 10	12	30	...	355	—477x	+2·6	C 5
—	13	45	...	40	„	„	C 6
1871.							
Oct. 8	16	30	...	97	—84x	+1·2	E 2
Nov. 8	15	15	...	43	—53x	+1·0	E 3
9	12	30	...	95	—52x	+1·0	E 1
Dec. 1	11	30	...	136	—30x	+1·0	E 4
4	10	40	...	199	—27x	+1·0	E 5
—	12	30	...	265	„	„	E 6

Sketches arranged in order of longitude.

	long.			lat.
	°			°
A 2	15	—790	x	+3·3
B 1	35	—699	„	2·9
C 6	40	—447	„	2·6
E 3	43	— 53	„	1·0
C 3	72	—461	„	2·6
E 1	95	— 52	„	1·0
E 2	97	— 84	„	1·2
C 1	103	—463	„	2·6
A 1	110	—816	„	3·4
D 5	112	—740	„	3·1
E 4	136	— 30	„	1·0
D 4	141	—766	„	3·2
B 2	142	—705	„	2·9
D 3	156	—766	„	3·2
C 2	157	—463	„	2·6
B 3	163	—705	„	2·9
B 4	194	—705	„	2·9
E 5	199	— 27	„	1·0
D 1	203	—705	„	2·9
D 6	226	—761	„	3·2
D 2	252	—707	„	3·0
B 5	260	—705	„	2·9
E 6	265	— 27	„	1·0
B 6	301	—707	„	3·0
C 4	311	—467	„	2·6
A 3	320	—767	„	3·3
C 5	355	—447	x	+2·6

Assumed daily rate of rotation, 870°.2+x.

Errata. At page 12, No. 109, line 11 from the bottom, for *Browning with* read *Browning— With.* Page 16, line 3, for *this lady* read *the lady.*

Books received.—Historical note on the method of Least Squares, by Cleveland Abbe, H.M. *Scottish Meteorology*, 1856—1871, computed at the Royal Observatory, Edinburgh. New Theory of the Figure of the Earth. By W. Ogilby, Esq. Longmans, Green & Co. 1872.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1871.

Fletcher, I.

To Jan. 1872.

Williams, J. M.

To March, 1872.

Brothers, A.
Elliott, R.
Guyon, R.

To April, 1872.

Lewis, H. K.
Loder, E. G.

To June, 1872.

Gooch, Miss
Metcalfe, Rev. W. R.
Neison, E.
Sargent, Rev. J. P.
Slater, J.

To July, 1872.

MacAdam, J. V.

To Sep., 1872.

Pratt, H.

To Dec. 1872.

Banks, W. L.
Cunningham, G.
Davies, Rev. R. P.
Escombe, R.
Freeman, D. A.
Hunt, G.
Lee, Allen
Monk, Dr.
Rylands, T. G.
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Warriner, H.

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Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to John C. Jackson, at Lower Clapton, London, E.

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 112. APRIL. 1872.

ECLIPSE EXPEDITION.

We are glad to call attention to a letter from a much valued correspondent, upon the extraordinary and discreditable absence of any information whatever, concerning the results of the Eclipse Expedition, from the last meeting of the Royal Astronomical Society. We quite agree with our friend, that whatever was the reason that induced those Fellows of the Society who took a part in the expedition to withhold the information from that body to which they belong, and which specially devotes all its resources to these subjects; which, moreover, is at its own cost going to publish the results of several eclipse expeditions; such conduct on their part is alike a reproach to themselves as it is a slight to the Royal Astronomical Society.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Fifth Meeting, March 8th, 1872.

Professor Arthur Cayley, F.R.S., *President*, in the Chair.

Secretaries—E. Dunkin, Esq., and R. A. Proctor, Esq.

The minutes of the last ordinary meeting were read and confirmed.

Seventy-three presents were announced and the thanks of the Society voted to the respective donors.

G. W. Roberts, Esq.,
Rev. S. J. Johnson, and
A. Hertage, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read :—

Measures of the Binary Star ξ Ursæ Majoris : by Mr. Knott.

During the last two months Mr. Knott has obtained three sets of measures, with the following results :

Position.	Distance.	Epoch.
°	"	
31·60 ...	1·092 ...	1872·028
29·69 ...	1·111 ...	1872·088
28·15 ...	1·052 ...	1872·138

The measures were made with a wire micrometer, on a refractor by Alvan Clark, of 7½ inches aperture, with powers of 450 and 515.

On the Aurora of February 4, 1872 : by Mr. Finlayson.

The author, writing from Dover, suggests that as it is probable many other persons saw the phenomenon, comparisons between his observations and those made at a distance would give some information as to the height of the aurora. In the early part of the evening the clouds were low, and reflected a blood red light, which seemed to show its origin was at a small elevation, but as the aurora was seen simultaneously at Florence, Constantinople, &c., it is clear this was not the case. Between ten and eleven o'clock the sky became perfectly clear, and the streamers radiated from a point in the constellation Gemini, between the principal stars and Jupiter, and if the radiant point differed at other stations, the approximate height of the aurora, and whether within or external to our atmosphere, might be deduced.

On the Russian preparations for the Transit of Venus : by M. Otto Struve.

These preparations are progressing satisfactorily and regularly. From the inquiries as to the meteorological conditions of the proposed stations the most favourable results may be anticipated, especially as to those on the Pacific coast. Two in or near Persia appear rather doubtful. There will be a chain of twenty-four stations extending across the Russian empire, from Kamtschatka to Circassia. Each of these will be equipped with one instrument only for observing the transit. These include heliometers, photoheliographs, and equatorials of various sizes. The observers are pretty well decided on, and they will assemble at Pulkowa for training in the present year. The twenty-four observers will not be required to determine the geographical position of their stations, but this will be done afterwards where successful observations have been obtained, by the regular naval staff. In Germany the preparations are not so far advanced, but the necessary funds will probably be voted this spring. Meanwhile M. Winnecke is occupying himself with the photographic apparatus, and M. Zöllner with preparations for the spectroscopic observations.

Mr. Dunkin said this was a very satisfactory account, showing there would be twenty-four places in the Russian empire where observations would be made to be used for comparing with the stations occupied by England, Germany, and other nations. With respect to the five places selected by the Astronomer Royal for our expeditions—viz., Alexandria, Auckland in New Zealand, Kerguelen's Land, Rodriguez, and Woahoo, Mr. Airy had lately had reason to change from Auckland to Christ Church, in New Zealand, as he found that there was a much better chance of fine weather, and the sun would be higher there.

Note on the Nebula surrounding η Argus: by Mr. Russell.

The author, who is the Government astronomer at Sydney, referring to Mr. Lassell's paper on the supposed changes in the above nebula, quotes Mr. L's. expression of regret that Mr. Russell had not sent a drawing with the paper forwarded to Sir J. Herschel, and which was handed to Mr. Lassell. Mr. Russell now says that on 24th March, 1871, he sent to Sir John Herschel four copies of a drawing of the nebula, accompanied by measures of the stars, and full particulars of the instruments employed, and that on the 13th May he sent further papers to Sir John. He remarks, it is, therefore, very unfortunate that through Sir John's illness and death the papers got into Mr. Lassell's hands without the accompanying drawings.

On the Total Solar Eclipse of December, 1871: by Mr. Russell.

The Royal Society of Victoria having arranged to observe the eclipse, the Government of New South Wales voted 300*l.* for the same purpose, and the author with five other persons started on the expedition in company with the Victoria observers on November 27. They proceeded to Sidmouth and established their two observatories on a sandbank in the harbour.

Mr. Russell had a number of telescopes both equatorially mounted and otherwise. One was fitted with a camera at the eye end to photograph the eclipse, and an ordinary photographic camera was also mounted for the same purpose. The instruments were all put up and adjusted in good time, and photographic practice commenced. They ascertained that it was quite possible to take a plate out of the bath, keep it for 10 minutes, expose it, keep it for 10 minutes more and then develope it, without injury to the result. A violent storm of lightning and rain occurred the night before the eclipse, and the day itself was most unfavourable. Just before the totality a thin crescent of light was seen, but during the totality nothing could be detected but a faint light in the sun's direction. Nine plates were prepared and two exposed for 40 seconds each; but no trace of a picture was obtained. It was by no means so dark as expected, but a peculiar blue tint pervaded the atmosphere. There was little difficulty in reading ordinary print. About fifteen miles to the north the eclipse was seen by the crew of a small vessel. Mr. Russell was unable to obtain any spectroscopes, but could have had more telescopes had spectroscopes been procurable.

Capt. Noble and other Fellows expressed their regret that the Society had not received any accounts of the Eclipse from the numerous successful observers, and it was explained that the expedition having been organised by the British Association, who obtained the funds from the Government, the reports would probably be made to that body in the first instance, but that there was little doubt they would be handed to the Astronomical Society for publication, and that every Fellow would obtain a complete account of all the eclipses from 1860 to 1871.

Observations de la Planete 117 (*Lomia*): by M. Stephan.

These were made between September 12 and October 1, at Marseilles.

Nebuleuses découvertes et observées a l'Observatoire de Marseille: by M. Stephan.

This was a table of positions with remarks.

On the longitude of Teheran: by Col. Walker.

The experiments to determine this point were made in September last by means of the Indo-European telegraph. Col. Walker being in London and Major St. John at Teheran. The signals were sent to and from Greenwich and Teheran, and although the distance was 3,870 miles, and five relays were necessary, the time occupied was less than half a second, showing that the line is in a high state of efficiency. The result for Teheran was 51°54′ 56″ E. of Greenwich, which agrees very closely with the longitude, as calculated from Madras, the position of which observatory has been obtained during the Indian Survey, but it is hoped that it will soon be possible to connect Greenwich and Madras by telegraph, and obtain the longitude in that manner.

Mr. Dunkin compared the velocity of the current in these experiments with the American result of 7,200 miles in 8-10th's of a second, and showed that the Teheran velocity was slightly slower, but two more relays were used, so that the results are fairly uniform.

Summary of Sun Spot Observations at Kew during the year 1871: by Messrs. De la Rue, B. Stewart, and Loëwy.

The figures for each month were given, the total being that on 219 days 271 new groups were registered, and that there were no clear days without spots. A comparison of the two years 1871 and 1870 shows that the latter year included the maximum of spots. Not only was the number of new groups less in 1871, but the magnitudes were smaller. This bears out the opinion that during the progress of a period to maximum, there is an increase of area from day to day and year to year. During last year one spot appeared in the unusually high latitude of 43°, and several others nearly as high, but they were small as compared with those in the usual zone of spot activity, and appear to be the result of violent and sudden eruptions.

On the Use of the Two Eyes in detecting the Motion of the Clouds, etc.: by Mr. Percival.

On Uniformity in the Measurement of Position-Angles with the Telescope: by Captain William Noble.

This paper was designed to place on record an oral suggestion made on the night of January 12 last. The suggestion was that one uniform system of measuring position-angles in the field of a telescope should be adopted. Every double-star observer in the world, without exception, measures the angle made with the meridian by a line joining the two components of the system, in a manner which is well-known and in which (assuming the ordinary Huyghenian or the Ramsden eye-piece to be employed) the bottom of the field is, of course, the true north; and the degrees are measured from this point to 90° on the right, and so round the circle. When, however, we come to study the predictions of occultations of stars by the moon, given in the "Nautical Almanac," we find the angles at which disappearance and reappearance are computed to take place no longer reckoned from the north round by west, south, and east; but having their initial point at the south, and being measured round by east, north, and west. No reason is assigned for this, and it seems to introduce a wholly needless complication, and one particularly embarrassing to the student and young astronomer; and it was submitted that the mode of reckoning angles in the case of lunar occultations should be assimilated to that employed for measuring the position-angles of double stars. This need not, of course, prevent a supplementary calculation of the angle from the moon's *vertex*, if thought necessary; but even this should be measured in the same direction.

Note on an Unsuspected Cause of Diffraction Phenomena in a Telescope: by Captain Noble.

Some little time ago in observing Jupiter, the author remarked certain emanations which appeared to have their origin in diffraction. He was very much puzzled to imagine in what way they arose, as his telescope is excellent and in perfect order; and so far as he could see by looking up the tube at the Moon or Jupiter, the tube itself was free from obstruction. However, about the middle of last month, when observing the sun one morning, upon removing the eye-piece, he happened to glance obliquely up the tube, and saw brilliantly illuminated by the sun a perfect *grating* of excessively fine spiders'-webs spun vertically across the interior of the telescope, somewhat within the focus of the object-glass. He speedily removed the offending lines, and had the pleasure that same evening of viewing the Jovian system shorn of all its optical appendages. The author could not say what species of spider produced a web of such extraordinary tenuity, but it certainly must be an extremely minute one, not only on account of the excessive fineness of the filaments which it spins, but also in order that it could have found its way inside of a tube so thoroughly and carefully closed.

Col. Strange said that there certainly was an insect which had an affection for spinning in telescope tubes, as he had seen instances of it.

Dr. Huggins remarked, that the spiders had already found their way into his large telescope, where, however, they appeared to do no harm; but in a transit they had made use of the spider lines already there, and spun the web upon that foundation.

The Source of Solar Heat: by Mr. Hall.

The author supposes that the sun is slowly and continuously contracting, and thereby produces an enormous amount of heat, and enters into calculations to show that it would be ages before any visible diminution of the sun's bulk would be perceived by us. The contraction, though so small as not to disturb our usual notions about the sun, would yet be a cause adequate to produce the resulting effect. Some further observations on the contraction of other bodies are added.

Note on Colour as affected by variation of Optical Power: by Col. Strange.

At a recent discussion at one of the Society's Meetings on the colours of the planets, Col. Strange expressed an opinion that of the three elements—colour, form, and size—it was most difficult to compare observations of the first by the same observer at different times. He has lately had an experimental illustration of the difference produced by the use of increased optical power. Being at a theatre with two ladies, one reputed to have an excellent eye for matching colours, and the other a born artist, their attention was attracted by the dress of a lady at a distance, which his companions pronounced *pink* and he thought *yellow*: upon using an opera-glass his opinion was confirmed, and the ladies, too, when thus optically assisted, admitted the colour was yellow. The dress was not all alike in colour, and it was a very pale tint. The light was strong, and the distance the diameter of a small theatre. This bears on the question of planetary colours as seen under different circumstances, and Mr. Lassell has recently stated that the colours of Jupiter are best seen with high powers.

Capt. Noble enquired whether the curtain or act-drop was up or down at the time, as the effect of contrast on the retina might have produced the confusion?

Col. Strange: The effect was noticed at all times of the evening. I always saw the dress yellow, the others only when using the glass. I made a point of getting near the lady, and finding out that it was really yellow, and that it was a fabric raised in parts.

On a Double Image Micrometer: by Mr. Browning.

A Fellow of the Society having asked for a double-image micrometer, Mr. Browning promised to do his best, but hardly knew which form he disliked most. The article is a desideratum, as it requires no light to put out the object, and can be used with a bad clock or none at all. The plan he hit on was to divide a Barlow lens. He did not actually construct a Barlow lens, which is a difficult matter, and then cut it, but a third lens of a compound eye-piece might theoretically be so considered. The power was altered by using stronger eye-pieces in front.

On a Telespectroscope for Solar Observations: by Mr. Browning.

The author had lately introduced and recommended a compound prism, and proposed now to use one in making a simpler solar spectroscope. At present the whole battery of prisms is very heavy, and, although a special contrivance is described in *Schellen,* it possesses great leverage, and cannot well be used in ordinary telescopes. He had, therefore, constructed the instrument exhibited, which, though of light weight, by using a compound prism was equal in effect to twelve ordinary prisms.

On an Automatic Universal Spectroscope: by Mr. Browning.

Another instrument which Mr. Browning exhibited and described was a spectroscope that could be used for any purpose, either in the laboratory or observatory, and in which the dispersive power could be varied as well as the magnification. It had a considerable number of prisms, but by interposing a reflecting prism in any part of the train, any number could be cut off as required, and the power thus varied from high to low. All the prisms are automatically adjusted for the minimum angle of deviation, and the source of light and telescope remained fixed during the changes of dispersive power.

Capt. Noble stated that as to the double-image micrometer, John Dollond first cut a lens in half, and thus made a micrometer, but he believed that the matter dropped. Sir D. Brewster described a micrometrical telescope made by shifting a lens up and down in the tube, and Dr. Pearson suggested dividing this lens, but he (Capt. N.) thought the idea never went beyond being put on paper.

Mr. Buckingham said he possessed the original Dollond micrometer.

Capt. Noble said it might be an encouragement to the possessors of small aperture telescopes to mention that on last Tuesday, with his 4.2 inch equatorial and a Browning star spectroscope, he had got upon a solar prominence and saw the hydrogen and sodium bright lines C, D, and F, and he believed anyone by travelling round the sun would get some of the Fraunhofer lines reversed. On another day he saw them broken, indicating some singularly formed prominence.

Dr. De la Rue said he took a good deal of interest in the micrometer question, and must call attention to Mr. Airy's double image micrometer, which he (the speaker) had possessed many years, and he could not but think Mr. Browning's resembled it almost exactly. He felt sure that Mr. Simms would be able to corroborate this. He also wished to mention that a M. Cornu, now in England, had contrived a prism which, by reflecting the rays four times backwards and forwards, gave nearly the same power as Mr. Browning's.

Mr. Huggins would make only one remark. M. Cornu used a very large prism, with a large telescope and long collimator. He, therefore, might get a great dispersion of the lines, but it was not so much due to the prisms as in the spectroscope on the table.

Mr. Browning said he had heard of M. Cornu, but had not seen him. He understood that M. C. advocated high magnifying power which he thought as good as dispersion, but there was a great difference in the result. To get a ray reflected backwards and forwards four times in a prism would require a very large piece of glass which, he thought, could not be obtained.

Dr. Huggins said silvered glass was used.

Mr. Browning: Then we get colour and lose much of the light.

A gentleman remarked that at the Royal Institution, Cork, there used to be a $3\frac{3}{4}$ inch Dollond telescope, said to be the brother of Dr. Kitchener's *Beauclerk,* which had a double-image micrometer, formed by a divided lens fitting over the object-glass. It was not an achromatic lens, but seemed a very flat concave one.

Col. Strange: This would produce the effect, but would require much more actual motion of the semi-lenses than if placed near the focus of the object-glass. Ramsden's Dynameter or Dynamometer is another form of double-image micrometer, but this is placed exterior to the eye-piece. Mr. Browning's is intermediate, between the Dollond and Ramsden, and has the advantage that it avoids distortion of the image.

Dr. Huggins said he possessed a Dollond micrometer made for

Mr. Lawson. It has a divided concave lens placed within the focus of the object-glass, and only differed from a Barlow lens in not being achromatic.

Dr. De la Rue: Airy's micrometer has a concave divided lens, and, I think, is furnished with three separate positive eye-pieces to vary the power. The semi-lenses are tilted, so as to get the images in the same plane.

Mr. Carpenter said he had often used the Astronomer Royal's micrometer, and taken it to pieces. It was a four-glassed eye-piece with the third from the eye concave and divided.*

On the Variation of the Position of the Orbit in the Planetary Theory: by Prof. Cayley.

On a Pair of Differential Equations in the Lunar Theory: by the same.

The President, having resigned the chair to Mr. Lassell, gave an oral explanation and illustrations of these papers.

The meeting then adjourned.

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* It may be useful to mention, as the discussion showed, that the Astronomer Royal was not the inventor of a double-image micrometer formed by dividing a lens, but he was the first to show how it could be made achromatic and free from distortion. In his original form the divided lens was convex, but about 1850 he adopted a concave lens, which is a great improvement. The power is changed by varying the eye-lens. See *Monthly Notices*, vols. 6, 10, 26, and 27.—REP.

RUTHERFURD'S PHOTOGRAPHS OF THE MOON.

We have received a beautiful specimen of these charming photographs. Nothing can surpass the admirable definition. It has been determined to issue them as photographs, as it might otherwise be suspected that they were not absolutely faithful copies. If kept carefully, there is no fear of their permanence.

LUNAR MAP AND CATALOGUE.

Mr. Birt has issued his annual report of the progress and financial condition of this work. We should have been glad to have learned that it had met with greater success, and that the subscriptions of the part year would have warranted the issue of the fifth area of the map; nevertheless, the report and balance-sheet show that sufficient interest in it is manifested to enable Mr. Birt to continue his labours. We gather from the report that a considerable portion of time has been consumed in the Plato discussion, but not without important results bearing on the present condition of a small area of the moon's surface, and showing the importance of placing in the hands of selenographers as extended a record as possible of the condition of other portions. The subscriptions for the first year, which are, as might be expected, the largest in amount, have more than defrayed the expenses of producing the fourth area of the map, and monogram of the Mare Serenitatis, which has been spoken very highly of. We find it is the intention of Mr. Birt to issue, as soon as possible, to subscribers of three years standing a portion of the catalogue, with synonyms and copious references to the works of previous selenographers, accompanied by critical, explanatory, and illustrative notes. We wish the work success, and hope that the acquisition of new subscribers will place additional funds at Mr. Birt's disposal.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

DESIDERATA.

I cannot but express my regret that Mr. Cocks' scheme for supplying a small sidereal clock for 5*l.* (*Astronomical Register* for August, 1871, page 179) was allowed to fall to the ground, as from the photograph I obtained from him it appeared to be the very article required by many possessors of small telescopes. After some correspondence, however, I learnt that a sufficient number of names had not been received to render the project remunerative. This result I cannot but attribute, in a great measure, to the doubtless well-intentioned letters of one of your correspondents, pointing out the superiority of a clock with a 40-inch pendulum. Of this there can be no doubt; but it should be borne in mind that the purchasers of small telescopes, for whom the clock at five pounds was intended, are those who are unable or unwilling to spend large sums on astronomy; and, therefore, if they erect any shelter for their telescope it is not likely to be much larger than the instrument requires. For persons so circumstanced a large 6-foot clock would be utterly useless, as it could not stand in the miniature observatory, where a timekeeper like that which Mr. Cocks proposed to supply, though of course not of first-rate accuracy, would enable its possessor to use the circles of his small equatorial in picking up stars by day, nebulæ, etc. As I am placed, with only just sufficient room to work the equatorial, such a clock would be more useful to me than a tall ninety-guinea instrument with its compensated pendulum.

VECTENSIS.

AURORA BOREALIS.

On Feb. 4, soon after sunset, in bright twilight, two or three auroral, clouds of glowing crimson were observed in the South. As night came on, the sky in that direction became fitted with similar appearances ; and only for the formation of a corona in the usual position, south and east of the zenith, the display might have been referred to an extraordinary extension of an Aurora Australis. For a considerable time, while the south was brilliantly illuminated ; the north, though unclouded, looked particularly dark and cheerless ; and, though it subsequently contributed to the corona, still it played only a very subordinate part on the present occasion, when the aurora drew its chief supplies from the opposite quarter of the heavens.

The corona was of striking splendour, its many-coloured beams coming up from all sides like a gathering of rainbows. It was formed at 7h. 30m., Dublin mean time, about 18 degrees south, and four or five degrees east of the zenith, changing its position among the stars, while accompanying the earth in her rotation. At one time there appeared about a third of a perfect corona with a white beam laid across the apex, reminding me of Mr. Carpenter's beautiful view of the comet in the current number of the *Register.*

The spaces between the brightest beams looked exceedingly dark by contrast, and conveyed the impression of *black* rays so well that, doubtless, in the case of any one who had a theory to be supported by it, the illusion that they were objective phenomena would be very complete.

Green and crimson, especially the latter, were the predominant colours of this aurora, and both gave a green line in the spectroscope. This I could distinctly see by comparison with the spectrum of a lamp. A faint red light might sometimes, with difficulty, be discerned, and there was a trace of a continuous spectrum from the green line toward the violet end.

At 9 o'clock Sirius was sparkling with unusual fitfulness in a flood of red. Shortly afterwards a fan of white light spread up from the south-east; and so perfect was the mimic dawn, that one might almost imagine that a strange sunrise was about to follow.

At about 10 o'clock the colours grew fainter everywhere, but brightened at intervals until midnight, when clouds came on and prevented any further observation.

Millbrook, Tuam: J. BIRMINGHAM.
February 8, 1872.

ANOTHER FINE AURORA.

Sir,—The auroral display of February 4, which seems to have extended all over Europe, was not seen so well here as in most parts, owing to the prevalence of cloud. Still we caught sight of it sufficiently to show what its grandeur must have been. At 6h. 7m. a rosy light was visible in an opening of the clouds in the S.S.W. At 6.35 the clouds began to break. Orion, Taurus, the Pleiades, came into view, and they were seen suffused with bright red vapour. At 6.45 Jupiter came out, and α and β Geminorum above him with a light-coloured flickering streamer shooting across the planet over the rosy brightness. At 6.50 the sky suddenly broke in all directions, and for ten or twelve minutes it was in a great measure clear. Streamers of a greenish colour, side by side, with brilliant red columns, converged to a point overhead. For two or three minutes they gave the zenith the appearance of an immense umbrella, a peculiar sight which I saw fully developed in the aurora of May 13, 1869. The coruscations of the late aurora, during the brief interval of clear sky, were intensely vivid; more so, I consider, than in any aurora I have seen, and that is why I am induced to forward a notice of it. The beautiful hues of the phenomenon, with the brighter stars shining through it, contrasted remarkably with the dark clouds. After 7 p.m. the aurora was only visible through the breaks in the clouds, and after 8 p.m. the sky was perfectly dense, and rain commenced to fall.

Upton Helion's Rectory, Crediton, Yours very faithfully,
Devon: Feb. 8, 1872. S. J. JOHNSON.

THE NOMENCLATURE OF COMETS.

A correspondence has been going on for some weeks past in the *Astronomische Nachrichten* on this subject, originated by the editor in consequence of the confusion which has crept in with respect to the Comets of 1871, owing to their following rather closely upon one another, whilst the dates of their perihelion passage could not in some instances be certainly determined with promptitude.

In the general indexes to the first twenty volumes of the *Astronomische Nachrichten.* The designations of the Comets were first introduced by means of Roman numerals, and they were arranged in the order of discovery. The compiler of the index of Vol. XXVI. made the order dependent on the epoch of perihelion passage, and this system has been uniformly adopted since then in the pages of this publication. In 1863 the numbers of the Comet had continually to be altered, and alterations had also to be made in the accounts sent in by the observers. These various inconveniences are very generally admitted, and M. Oppolzen suggests a system based entirely upon dates of discovery, arranged in the following fashion :—

The first Comet of 1871 having been discovered on April 7, 1871, he would symbolise the Comet as :—

$$\textit{Comet}\quad 18\frac{7}{\text{IV.}}71.$$

The second Comet of the same year having been discovered on June 14, he would thus indicate it :—

$$\textit{Comet}\quad 18\frac{14}{\text{VI.}}71.$$

and so on. A Comet known by a specific title he would allude to as :— *Comet of Encke*, 1871. How far this system would work is, I think, open to serious question. G. F. CHAMBERS.

JUPITER AND SATELLITES.

Sir,—The transits of Jupiter's satellites are now taking place at lower Jovian latitudes, and will for some time continue to approach his equator, so that we may be able to collect observations sufficient to clear up some of the unsettled points in this system. It is at least doubtful whether succeeding transits really present 3 and 4 under a markedly different aspect. Permit me to invite the assistance of every observer, having sufficient interest and leisure, and to suggest two or three essential points in the inquiry—

1. The path of the satellite referred to zones or belts. (Mr. Gledhill's Nos. will be useful.)
2. Particulars of distance from limb (which may be estimated by the diameters of planet or satellite), or time from ingress to egress, when any change in tint or visibility occurs; or,
3. Peculiarities in shape or markings.

All sizes of telescopes will be useful, and if a good number of amateurs will help during the next three years, I hope we shall be furnished with sufficient evidence to determine whether the light and markings are permanent, and the rotation analogous to that of our moon.

As a small contribution, allow me to add what my 9-in. "With-Browning" showed of the Tr. of 3, December 29, with power 212.

The satellite traversed Gledhill's No. 5 a little below the centre of the belt. When about 3″ clear from the limb I completely lost it, and at 6″ it was distinctly coming out as a dark spot, very much smaller than its shadow (then on the disc). It became plainer and larger up to mid-tr., when the dark spot was elongated N.E., S.W. I thought in steadier moments I could see a brighter segment S.E. Its tint was dark grey, very different from the black umbra.

The latter was on the same belt, slightly S. of the path of 3. The air was not sufficiently good to allow the penumbra to be certainly seen until approaching the middle, and then it was not quite so easy as in Nov., 1869, when near the pole, but its breadth seemed about the same. At this time a bright speck just *f* it at least kept pace with the shadow for some time. Had this shadow been that of the 4th, the spot would have passed underneath and left it behind, causing, to an observer on Jupiter, the remarkable phenomenon of a solar eclipse, commencing on the E. of the sun. Under certain circumstances this might be nearly intermediate between two normal eclipses occurring near sunrise and sunset. The observation of this local retrogression will be interesting to those whose optical means are adequate. (Fuller details may be found in *Eng. Mech.* xiv., p. 387.)

Some changes on Jupiter would seem to have taken place since Mr. Gledhill's observations earlier in December. On the 29th, about 11h., there were two large (E. and W.) bright masses on the same meridian of belts 3 and 4, having dark borders and darker ends, about 15″ from the W. limb, with others in a similar position towards the E. A few quieter minutes, about 13h., the whole disc was covered with markings. The boundaries of the equatorial zone contained large white masses. White zone α had a large round brighter mass, with several *f* it. Zone β was of a similar character. Belt 2, ruddy chocolate, was irregular and knotty. No. 6 was broken about, with a curved dark line enclosing a large bright mass on β. The colour of the ground of the equatorial zone seemed to me a pure deep yellow, not ochre as in 1870, but having the darker portions usually seen hanging down from No. 4, between the bright ovals.

I am, Sir, yours very truly,
Bonner's Road, Victoria Park: T. H. BUFFHAM.
Jan. 12, 1872.

P.S.—Allow me to add, under the third point, that the position of markings, detected on a satellite, should be referred to the equator of Jupiter, and not to the *p* and *f* motion through the field.

I have obtained no observation worth mentioning since Dec.

Feb. 14, 1872. Yours truly, T. H. B.

JUPITER.

SIR,—On the night of Feb. 20, at 11½h., the face of the planet was a magnificent picture. Something, doubtless, was due to favourable circumstances, but more to an unusual display of the features, which lately have increased our interest, and attracted our attention. At this time, the whole of the disc was covered with spots, or other markings. The streak between No. 2 and No. 3 was narrow, and the space between it and No. 3 was filled with bright masses, interspersed with marbled markings. The whitest part of the disc was below No. 2, and even this was divided by an exceedingly fine line,—really another belt between No. 1 and No. 2. No. 2 was knotted, and also had on it one or two bright beads. The upper half of Jupiter was also full of detail. The three principal belts were very irregular, the general character being a dark stratum, on which were superposed lighter small elongated masses. One of these, in the latitude of No. 5, assumed large proportions—perhaps 6″ in length—its upper very dark boundary bulging out of the S. of the belt, while its fainter lower border dipped into the bright zone between No. 4 and No. 5.

The colour of the central part of the equatorial zone is still, to my eye, of a deep yellow, without any warmth of tint. Casual notice shows it extending across fully three-fourths of the planet. Careful watching, however, reveals it almost to the limb on the western extremity; on the other end, where the terminator is, it cannot be traced quite so far, (with power 212.)

The bright masses on the upper side of the zone I usually see of less regular sizes than they are generally drawn by your correspondents. At 10h. on the 21st Feb. one was observed having three or four times the area of its companions.

I am, Sir, yours truly
T. H. BUFFHAM.

Bonner's Road, Victoria Park:
March 15, 1872.

THE SHADOW OF JUPITER'S FOURTH SATELLITE.

SIR,—I have been enabled to scrutinise this shadow until the transit of March 6. When well on the planet, the umbra and penumbra were certainly distinguished with 212 and 320 on my nine inch "With Browning." The umbra was about equal to half the diameter of IV. outside; and the breadth of annulus of penumbra about half the diameter of the umbra. Still both parts of the shadow—which traversed the disc of Jupiter half way from the equator to the S. pole—were less clearly defined than in the shadow of III. The size of the umbra would appear to indicate that its exterior was merged with the denser part of the penumbra. Near mid-transit the shadows seem smaller and darker; near egress its compound character was again visible.

Soon after ingress, two small light spots were noticed, just preceding, and a little below the shadow. When the latter had reached the middle of its course, the two spots had gained some 1½" on it. Nearer the equator, the local retrogression would have been more marked.

I am, Sir, yours very truly,
T. H. BUFFHAM.

Bonner's Road, Victoria Park:
March 15, 1872.

JUPITER.

As well as I could see in weather that gives the worst telescopic definition, the slant streak that I noticed in Jupiter, on Jan. 11, has now become faint, but it has got additional features, which were first noticed on March 17. Referring to my sketch in the February number of the *Register*, an imperfect belt will be seen ending about half-way across the disc. This is Mr. Gledhill's No. 6, and above it is a belt which I will call No. 7, while still further I can sometimes distinguish another, which may be marked as No. 8. The slant streak, when first observed,* reached no higher than 7, but now it appears to extend to 8, or the dark region about the pole. In the angular space between it and 5, and reaching quite across, is a large dark spot, and under the spot a bright gap seems cut out of 5. No trace of these was noticed before March 17.

On Feb. 16, I remarked another slant streak rising in a similar direction from 5, in a place about two hours east of the first one, and, at the same time, a great thickening appeared above it in 7. From this thickening I perceived, on Feb. 24, a slant streak descending, and both streaks met at an angle at No. 6. On the same occasion I saw, for the first time, two slightly inclined, and very faint, dark, conical forms, with their bases on belt 3, and crossing the equatorial zone to 4, where they seemed to touch with their apexes two of the spots on the latter.

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* In the sketch the streak rises at too great an angle, and the space between 4 and 5 is too wide.

During February, No. 3 appeared to me not straight, but with three or four slight curves, and interrupted by bright spots in two places. This I have latterly not been able to observe.

Mr. Gledhill's new belt, which may be called 2b, never seemed complete. It distinctly terminated at two bright spots separated from each other about a tenth of the circumference. My failure to detect this belt during the present month, as well as the curves of No. 3, must be, most probably, attributed to the badness of the definition on the few occasions that the heavens were at all visible.

March 19, 1872. J. BIRMINGHAM.

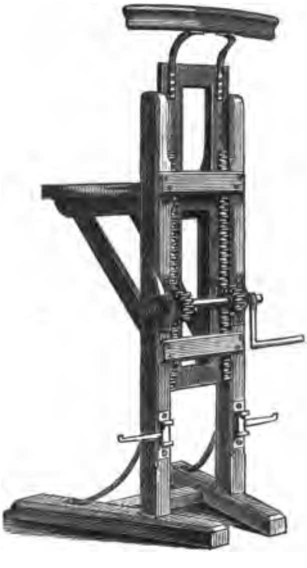
LUNAR TINTS.

Sir,—May I ask for a small space wherein to say a few words on the conversation at the meeting of the Royal Astronomical Society, which ensued on the reading of my paper relative to the floor of Plato. Although your report of that conversation is perfectly accurate, it is, I think, calculated to lead the general reader to conclude that the appliances of modern science were not employed in obtaining the results which formed the subject of my communication, and, consequently, a doubt may rest on their accuracy. It is quite true that instrumental determinations carry a much greater weight with them than estimations, but no one, except a selenographer who has had considerable practice, can form the least idea of the difficulty of determining instrumentally numerical values of lunar tints. A telescope is required which is furnished not only with a perfect clock motion, adjusted to the moon's diurnal motion, but a diaphragm of the nature of Dawe's eye-piece, with exceedingly small perforations to shut off every portion of the moon's surface, except that under examination, which must be kept steadily in the field while a number of graduated tints are compared, in order to select the one which agrees best with it. The wedge of coloured glass, of which I said "nothing could be better," would determine rather the intensity of the light reflected from the object than the colour presented by it. Up to this time "estimation" has been used in determining *brightness*, and in the lower part of the scale *colour*. Schröter, Lohrmann, and Mädler, adopted this plan, and although the scales of these selenographers are not identical, we do not question their determinations. I may remark in passing, that, however numerous the collected instances of brightness as determined by them may be, the observations of any particular object are but few; and as regards Lohrmann's and Mädler's, the dates are not given. In the case of Schröter, the date of each observation is recorded. The paucity of observations in a given instance is a strong inducement for re-determining brightness on every available opportunity. A well-trained eye can readily estimate minute shades of difference between the colours and brightnesses of neighbouring objects, and constant practice will enable two or more observers to come very close indeed in their estimation of colour and brightness. In the case of Plato, the differience between the lightest and the darkest floor is sufficiently great to preclude the possibility of the *same* observer mistaking dark for light, and the contrary, and when three observers, during a period of two years not in communication with each other, and using telescopes of different apertures, so closely agree as to furnish the materials of a curve which rises and falls with that of solar altitudes, there can be little room to doubt of the accuracy of a result which incontestably proves that the position of the sun in the lunar heavens affects the appearance of objects on the moon's surface, a principle long held by

selenographers, but, so far as I am aware, never proved ***numerically*** before. Regarding a very light floor as 0·10, and a very dark floor as 0·90; a curve deduced from the observations gives for each interval of 12 hours from sun-rise to sun-set on Plato, the following values :—Interval 0 to 12 hours sun's altitude 0° 0′·0 to 3° 54′·8. Tint of floor 0·30 to 0·33.
Interval 12 to 24 hours. alt. 3° 54′·9 to 7° 48′·1. Tint 0·33 to 0·36.
Interval 24 to 36 hours. alt. 7° 48′·1 to 11° 38′·2. Tint 0·36 to 0.39.
Interval 36 to 48 hours. alt. 11° 38′·2 to 15° 23′·3. Tint 0·39 to 0·42.
Interval 48 to 60 hours. alt. 15° 23′·3 to 19° 2′·0. Tint 0·42 to 0·45.
Interval 60 to 72 hours. alt. 19° 2′.0 to 22° 31′·3. Tint 0·45 to 0·49.
Interval 72 to 84 hours. alt. 22° 31′·3 to 25° 49′·5. Tint 0·49 to 0·52.
Interval 84 to 96 hours. alt. 25° 49′·5 to 28° 54′·3. Tint 0·52 to 0·54.
Interval 96 to 108 hours. alt. 28° 54′·3 to 31° 42′·7. Tint 0·54 to 0·57.
Interval 108 to 120 hours. alt. 31° 42′·7 to 34° 11′·5. Tint 0·57 to 0·60.
Interval 120 to 132 hours. alt. 34° 11′·5 to 36° 17′·5. Tint 0·60 to 0·62.
Interval 132 to 144 hours. alt. 36° 17′·5 to 37° 57′·8. Tint 0·62 to 0·64.
Interval 144 to 156 hours. alt. 37° 57′·8 to 39° 9′·2. Tint 0·64 to 0·65.
Interval 156 to 168 hours. alt. 39° 9′·2 to 39° 50′·5. Tint 0·65 to 0·66.
Interval 168 to 177, or meridian passage alt. 39° 50′·5 to 40° 0′·0. Tint 0·66 to 0·67. The declining sun gives the same altitudes and tints from meridian passage, reckoning in the reverse order,

Observatory, I am, Sir,
Cynthia Villa, Walthamstow: Your obedient servant,
January 9, 1872. W. R. BIRT.

NEW OBSERVING SEAT.



Sir,—The want of a comfortable seat suitable for observing with reflecting telescopes has been long felt. I beg to send you a photograph of an Observing Seat I have just constructed for my 8¼-inch "*Browning-With*" Reflector, which I find to answer its purpose very satisfactorily, and which may, therefore, be interesting to your readers.

There are many difficulties to be overcome in contriving a seat for reflectors on Alt-Azimuth stands :—

First, it is essential that in using it, the observer's legs should not be in front as on an ordinary chair, for it would then be impossible for him to approach his eye to the eyepiece in every position of the telescopes.

Secondly, it is necessary that the seat should be moveable vertically to at least double the height of its lowest position ; and, Thirdly, the height of the seat should be readily adjustable without the observer moving from it ; and at the same time the whole thing should be quite simple and portable.

The seat I have made attempts to comply with all these conditions. It consists simply of a saddle-shaped seat, attached to a frame sliding in a groove in two uprights, the height regulated by cogwheels and rackwork.

The whole is constructed of well-seasoned oak, with the exception of the " saddle " which is of lime.

The two uprights are firmly morticed into two horizontal bearers, braced together and strengthened by iron stanchions. The seat is of Lime wood, shaped and hollowed like a saddle, and the observer sits astride on it as on horseback. This " saddle " is fixed to what joiners call a " gallows-shaped bracket," firmly screwed to a frame sliding easily in a vertical groove in the uprights. Attached to this frame in front are two gunmetal racks, and at the top is fixed by iron supports, a curved oak bar like the back of a chair, which enables the observer to lean forward without fear of falling, and serves as a support for his arms in focussing, measuring, and observing with greater steadiness. The cogwheels are of gunmetal, and are fitted and keyed on an iron shaft working in front of the uprights. At one end of this shaft is an iron catchwheel which regulates the height of the seat.

The bearers are braced together behind the uprights, and are left open in front, so that when the telescope is at its greatest elevation, and its most distant position in Azimuth, one angle of the tripodic stand of the telescope can be admitted between the uprights, and thus allow the observer to get up to the eyepiece—this being the position of the telescope most difficult for any seat to be used.

The footrests are of iron and fixed to the uprights—they are moveable, and made on the principle of the rack-bracket on which a roasting jack hangs, having a round socket above and a square one below, so that when the seat is low down and they would be in the way, they can be easily turned inwards. (I should say that my reflector being of short focus, I find one pair of foot rests sufficient ; but with a *longer* telescope, a second pair would of course be necessary.)

To raise the seat when observing, it is only necessary to stand up on the foot rests and pull it up by the top bar ; to lower the seat, it is easy to stand on the foot-rests and with the right hand release the catchwheel, the seat will then fall of its own weight ; the height of the seat is thus most easily and readily adapted to the object under examination. The bearers rest upon small wheels in front, so that the observing seat can be run easily to and from the telescope.

The whole seat is very steady and firm, the arrangement of the bearers forming two sides of a triangle, make it difficult to upset sideways, and they are sufficiently long to prevent any unsteadiness backwards or forwards. It is very comfortable and sufficiently portable. I find no difficulty in carrying it into the garden each night I observe.

I am indebted to Mr. Browning for most kindly suggesting to me that it would be an advantage to have a small shelf fixed at the top of the frame under the curved bar, with holes pierced in it to contain the eyepieces mostly in use. Mr. Browning thinks also that if an upright iron bar were attached to one end of the curved bar, a light semi-circular frame of galvanized iron work might be made to swing on this, and after the observer had taken his place, he could turn it round and secure himself against the effects of wind—both very valuable suggestions which I shall endeavour to have carried out.

I append a few dimensions :—

Uprights	3ft. 7½in.
Horizontal bearers	2ft. 5in.
*Height of seat at lowest position	1ft. 10in.
Height of seat at highest position	3ft. 7in.
Greatest elevation of eyepiece of telescope being	5ft. 11in.

Burton-on-Trent : I am, Sir, yours faithfully,
March 9, 1872. E. B. KNOBEL.

P.S.—With regard to the cost of the above Observing Seat, I should perhaps mention that one of that size would be about £5, exclusive of making the patterns for the castings, the metal-work costing at least half the money. I did not aim at cheapness so much as simplicity and portability, but the expense might be much reduced by using other wood instead of oak, and also by having the cog-wheels and racks of iron instead of gun-metal, but they would not work so smoothly, and the seat would not be so durable. E. B. K.

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*A very trivial alteration in the position of one of the braces connecting the uprights would allow the seat to go 1½ inches lower.

We have also received an observing chair suited for a refractor, the particulars of which will be seen among our advertisements. It is remarkable as to lowness of price.

THE ECLIPSE EXPEDITION OF THE ROYAL ASTRONOMICAL SOCIETY.

Sir,—In common, I believe, with a very large number of those who crowded the meeting-room of the Royal Astronomical Society on the night of Friday last, I went down for the express purpose of hearing the details of the results of the late Indian Eclipse Expedition.

To my exceeding surprise and chagrin, not one syllable was said about it, save by a member of the council, who very pointedly referred to the conspicuous absence of those fellows who might reasonably have been expected to have been present, to have given us some information

Why then, I would ask, have the society not been favoured with any account of the observations made by their own fellows? I see it stated in the public prints, that the expedition was sent out by the Government in the representation of the British Association. It therefore might possibly be conceived and urged that the observations made were the property either of the Government or of the Association. In the first case, of course, no one could deal with them, and they would probably be printed by the Admiralty ; in the next, those who made them would have equally little control over their publication ; and would have to keep them warm until the meeting next August, at Brighton.

But, if I am rightly informed, there is a serial called *Nature* which has already contained reports of the Indian observations, and, unless I have curiously misread the newspaper, Mr. J. Norman Lockyer has been lecturing on this very subject at the Crystal Palace ; so that, at all events, he treats *his* observations as private property.

During the desultory conversation which ensued after the meeting broke up, it was hinted that the results of the late expedition are being saved up for the Royal Society. If this be so, I would simply express my opinion that any one who (being a fellow of the Royal Astronomical Society) would deliberately withhold information of a purely astronomical character from the Society solely devoted to the advancement of astronomy, merely that it might first be communicated to the "superior classes" at Burlington House, *ipso facto*, would enrol himself in a category to the exposition of whose manners and customs, the late Mr. Thackeray devoted a never-to-be-forgotten "book."

I am, Sir, your most obedient servant,
March 9, 1872. DESTITUTUS.

THE NATIONAL THANKSGIVING.

Sir,—It was stated in the newspapers that seats were to be reserved in St. Paul's Cathedral for the representatives of Science, on the occasion of the National Thanksgiving on the 27th of last month. I ask, in some wonder, is, or is not, Astronomy at the head of all the Sciences? And, if so, how is it that the Royal Astronomical Society was absolutely unrepresented amid the vast and heterogeneous assemblage which met in our great Metropolitan Church to offer up praise to Him whose glory the heavens so emphatically declare?

It is infinitely discreditable to the authorities that no invitations whatever were issued either to our President, Officers, or Council; in point of fact, that the very existence of the second of all the Learned Societies was absolutely and utterly ignored.

Possibly Cole, C.B., and his pushing impudent South Kensington clique, occupied the space supposed to be devoted to the *elite* of English intellect; but who—save the members of the Mutual Admiration Society at Brompton—would dare to assert that any of these people have the smallest claim to be regarded as men of science, or to sit in the place of our representative philosophers?

Whether other scientific bodies have received such treatment, and if so, whether they will resent it, I know not; but, as far as we are concerned, I regard the indefensible slight which has been put upon us as an insult to every

FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.
March 12, 1872.

T. CORONÆ BOREALIS.

Sir,—It will be remembered that, in May, 1866, this star suddenly burst forth, and rapidly decreased again; and that, after a smaller increase, it began in the autumn gradually to diminish. and continued doing so till the middle of 1867. Since that time, up to the beginning of this year, its brightness has not changed materially, though there have been slight and irregular variations. The last observation I recorded last year was on October 16, when it was just of its usual brightness. On January 14 it appeared to be slightly fainter, but the difference could be fully accounted for by error of estimation. I did not again look at it till March 5, at 11, when I was at once struck by the change, and found it perhaps half a magnitude fainter than usual, and decidedly fainter than I ever before saw it. I have looked at it several times since then, up to the 12th, but have not detected any further change, so that I cannot say whether its diminution continues or not.

I do not know what T. Coronæ was like before 1866, so that I cannot say whether it is now brighter or fainter than then.

Yours truly,
Sunderland: March 15, 1872. T. W. BACKHOUSE.

ASTRONOMICAL OCCURRENCES FOR APRIL, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m s.	h. m. Jupiter —
Mon	1	 4 50	Sidereal Time at Mean Noon, 0h. 40m. 36·24s. Conjunction of Moon and Saturn 3° 19′ N.	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	7 40 8 57 10 0 11 17	6 46·5
Tues	2			1st Ec. R.	8 24 6	6 42·8
Wed	3					6 39·1
Thur	4			3rd Ec. R. 2nd Oc. D.	8 3 54 13 42	6 35·5
Fri	5	7 23	Conjunction of Moon and Venus 3° 59′ N.			6 31·8
Sat	6		Saturn's Ring : Major Axis=37·31″ Minor Axis=14·59″	2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E.	7 59 10 32 10 54 13 28	6 28·2
Sun	7	12 31	● New Moon	1st Oc. D. 3rd Tr. I.	12 16 13 21	6 24·5
Mon	8	4 21 20 1	Conjunction of Moon and Mars 3° 42′ N. Conjunction of Moon and Mercury 6° 32′ N.	4th Tr. I. 2nd Ec. R. 1st Sh. I. 1st Sh. I. 1st Tr. E. 4th Tr. E. 1st Sh. E.	7 43 8 25 49 9 35 10 52 11 54 11 56 13 12	6 20·9
Tues	9			1st Ec. R.	10 19 34	6 17·3
Wed	10			1st Sh. E.	7 41	6 13·7
Thur	11			3rd Oc. R. 3rd Ec. D. 3rd Ec. R.	6 52 8 38 19 12 4 53	6 10·1
Fri	12	21 5	Conjunction of Neptune and Sun			6 6·5
Sat	13	6 55 8 6	Occultation of 5 Geminorum (6) Reappearance of ditto	2nd Tr. I. 2nd Sh. I. 2nd Tr. E.	10 37 13 10 13 32	Moon. — 4 30·2
Sun	14	23 24 11 48	Conjunction of Moon and Jupiter, 2° 38′ S. Near approach of 48 Geminorum (6)			5 20·5
Mon	15	10 11 11 0	☽ Moon's First Quarter Conjunction of Moon and Uranus, 3° 0′ S.	2nd Ec. R. 1st Tr. I. 1st Sh. I. 1st Tr. E.	11 15 11 30 12 47 13 49	6 10·4
Tues	16			1st Oc. D. 1st Ec. R.	8 40 12 15 4	6 59·3

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Wed	17		Sidereal time at Mean Noon, 1h. 43m. 41·10s.	1st Sh. I. 1st Tr. E. 1st Sh. E. 4th Ec. R.	7 16 8 18 9 35 10 22 32	7 46·8
Thur	18	7 59 9 16 10 14 11 10	Occultation of B.A.C. 3579 (6) Reappearance of ditto Occultation of ι Leonis (6) Reappearance of ditto	3rd Oc. D. 3rd Oc. R. 3rd Ec. D.	7 25 10 55 12 38 11	8 33·0
Fri	19	13 20	Conjunction of Mars and Mercury, 2′ 32″ N.			9 18·2
Sat	20			2nd Tr. I.	13 16	10 3·0
Sun	21					10 48·3
Mon	22			2nd Oc. D. 1st Tr. I. 2nd Ec. R.	8 13 13 26 13 36 15	11 35·1
Tues	23	1 37	○ Full Moon	1st Oc. D.	10 37	12 24·5
Wed	24	8 54	Inferior Conjunction of Mercury	1st Tr. I. 2nd Sh. E. 1st Sh. I. 1st Tr. E. 1st Sh. E.	7 55 8 2 9 10 10 14 11 30	Jupiter. 5 24·5
Thur	25			1st Ec. R. 3rd Oc. D.	8 39 30 11 30	5 21·0
Fri	26		Saturn's Ring: Major Axis=38·58 Minor Axis=15·02			5 17·6
Sat	27					5 14·1
Sun	28	11 18	Conjunction of Moon and Saturn, 3° 32′ N.			5 10·7
Mon	29	20 20	☾ Moon's last quarter			5 7·3
Tues	30					5 3·9
MAY. Wed	1			1st Tr. I. 2nd Sh. I.	9 52 11 5	5 0·6

THE PLANETS FOR APRIL.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	1 50 51	+13 41½	6″·8	1 10·1
	15th	2 23 32	+17 20	10″·0	0 47·6
Venus ...	1st	23 8 54	—6 54½	11″·4	22 24·6
	15th	0 12 20	—0 21½	11″·0	22 32·8
Jupiter ...	1st	7 28 15	+22 23½	36″·9	6 46·5
	15th	7 32 38	+22 16½	35″·2	5 55·9
Saturn ...	1st	19 29 4	—21 32½	14″·8	18 45·4
	15th	19 31 5	—21 29	15″·2	17 52·4
Uranus ...	2nd	7 57 19	+21 18	4″·0	7 11·6
	18th	7 57 43	+21 17	4″·0	6 9·1

Mercury. A good opportunity is offered for observing this planet at the beginning of the month, as it passes the meridian about one hour and ten minutes after noon, for the first week, the interval decreasing until the 23rd, on which the planet transits twice, at four minutes past noon and at one minute before noon on the 24th.

Venus throughout the month rises about half an hour before the sun.

Jupiter will be well visible throughout the month till half-past two at the beginning of the month, the interval decreasing to a quarter-past one.

Saturn may be seen in the morning, but is too low to be worth observing.

Uranus is still well situated for observation.

SUN.

Greenwich, Noon. 1872.		Heliographical longitude of the centre of			Heliographical latitude the sun's disc.		Angle of position of the sun's axis.
		°			°		°
April 1	...	19·94	+91 δ ξ	...	—6·39	...	333·57
2	...	33·15		...	6·33	...	333·54
3	...	46·36		...	6·27	...	333·52
4	...	59·57		...	6·21	...	333·50
5	...	72·79		...	6·14	...	333·50
6	...	86·00		...	6·07	...	333·49
—							
7	...	99·21	+97 δ ξ	...	—6·00	...	333·50
8	...	112·43		...	5·93	...	333·51
9	...	125·65		...	5·86	...	333·53

10	...	138·86		...	5·79	...	333·56
11	...	152·08		...	5·71	...	333·60
12	...	165·30		...	5·63	...	333·64
13	...	178·52		...	5·55	...	333·69
—							
14	...	191·74	+104 $\delta\xi$	...	−5·47	...	333·74
15	...	204·96		...	5·39	...	333·81
16	...	218·18		...	5·31	...	333·88
17	...	231·41		...	5·22	...	333·96
18	...	244·63		...	5·14	...	334·05
19	...	257·85		...	5·05	...	334·15
20	...	271·08		...	4·96	...	334·25
—							
21	...	284·31	+111 $\delta\xi$	...	−4·87	...	334·35
22	...	297·53		...	4·78	...	334·47
23	...	310·76		...	4·68	...	334·59
24	...	323·99		...	4·59	...	334·72
25	...	337·22		...	4·49	...	334·86
26	...	350·45		...	4·40	...	335·01
27	...	3·68		...	4·30	...	335·16
—							
28	...	16·91	+118 $\delta\xi$	...	−4·20	...	335·32
29	...	30·15		...	4·10	...	335·49
30	...	43·38		...	4·00	...	335·66

Assumed daily rate of rotation, 14°.2+$\delta\xi$.

JUPITER.

G. M. T.		Zenographical longitude of the centre of ♃'s disc. 6h.	8h.	10h.	12h.	Latitude. 12h.	Angle of pos. of ♃'s axis. 12h.
1872.		°	°	°	°	°	°
April 1	...	331	44	116	189	+1·0	10·11
2	...	122	194	267	340		10·13
3	...	272	345	58	130		10·15
4	...	63	136	208	281		10·18
5	...	214	286	359	71		10·21
6	...	4	77	149	222		10·24
—							
7	...	155	227	300	12	+1·0	10·27
8	...	305	18	90	163		10·30
9	...	96	168	241	314		10·33
10	...	246	319	32	104		10·36
11	...	37	110	182	255		10·39
12	...	188	260	333	45		10·43
13	...	338	51	123	196		10·47
—							
14	...	129	201	274	346	+1·0	10·51
15	...	279	352	64	137		10·55
16	...	70	142	215	287		10·59
17	...	220	293	5	78		10·63
18	...	11	83	156	288		10·67
19	...	161	234	306	19		10·71
20	...	312	24	97	170		10·75
—							

21	102	175	248	320	+1·0	10·79
22	253	326	38	111		10·84
23	44	116	189	261		10·89
24	194	267	339	52		10·94
25	345	57	130	202		10·99
26	135	208	280	353		11·04
27	286	358	71	143		11·09
28	76	149	221	294	+1·0	11·14
29	227	299	12	84	0·9	11·19
30	17	90	162	235	„	11·24
May 1	168	240	313	25	„	11·29
2	318	31	103	176	„	11·34
3	109	181	254	326	„	11·40
4	259	332	44	117	+0·9	11·46

Assumed daily rate of rotation = 870°·72.

MOON.

Libration.
Selenographic long. and lat. of the point on the moon's surface, which has the earth's centre in the zenith.
Greenwich, Midnight.

Terminator.
Selenographic longitudes of the points in latitude 60° N., 0° and 60° S., when the sun's centre rises or sets.

	long.	lat.	6° N.	0°	60° S.
				Sunset.	
1872.			°	°	°
April 1	0·0	+4·2	—14·0	—11·6	—9·3
2	+1·0	5·3	26·2	23·8	21·4
3	2·0	6·1	38·3	36·0	33·6
4	3·0	6·5	50·5	48·2	45·7
5	3·9	6·6	—62·7	—60·4	—58·1
6	4·5	6·2			
7	+4·9	+5·5		Sunrise.	
8	5·0	4·5			
9	4·8	3·3	+72·9	+70·7	+68·5
10	4·3	1·9	60·6	58·5	56·3
11	3·4	+0·5	48·4	46·3	44·1
12	2·3	—0·9	36·1	34·0	32·0
13	+1·0	2·2	23·9	21·8	19·8
14	—0·4	—3·5	+11·7	+ 9·6	+ 7·6
15	1·7	4·6	— 0·6	— 2·6	— 4·6
16	2·9	5·5	12·8	14·8	16·8
17	4·0	6·2	25·1	27·1	29·0
18	4·8	6·6	37·3	39·2	41·1
19	5·4	6·7	49·5	51·3	53·2
20	5·7	6·5	61·8	63·6	65·5
21	—5·5	—5·9	—74·1	—75·9	—77·7
22	5·0	4·9		Sunset.	
23	4·3	3·7	+78·2	+80·0	+81·8

24	3·4	2·2	66·1	67·8	69·5
25	2·4	—0·6	54·0	55·6	57·3
26	1·3	+1·0	41·8	43·5	45·1
27	—0·1	2·7	29·7	31·3	32·9
—					
28	+1·0	+4·1	17·5	19·1	20·6
29	2·1	5·3	+5·4	+6·9	+8·4
30	3·0	6·2	—6·8	—5·3	—3·9
May 1	+3·8	+6·6	—19·0	—17·5	—16·1

The sun's disc passes the true horizon of Linné on April 14, from 8h.·9 to 10h.·1, rising.

THE PLANET JUNO.

The Minor Planet *Juno* will be in opposition on the 20th inst.

Date.	R. A. h. m. s.	Dee. ° ′
8th	14 21 57	—1 49½
12th	14 20 27	1 20½
16th	14 17 23	0 52½
20th	14 14 14	0 25½

THE PLANET VESTA.

Mr. G. J. Walker sends us the following particulars :—

The minor planet Vesta is well placed now for observation. It is very near ν Cancri, 6th magnitude, and will be a very little below it in the beginning of April. It has a bright, sharp, stellar appearance. There is a small star to the left of ν, less bright than the planet, which seems of 7th magnitude.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN APRIL, 1872.

By W. R. Birt, F.R.A.S., F.M.S.

The lists of lunar objects which have been published monthly during the past year, and the first three months of the present year, contain 352 of the 404 named craters, &c., in Webb's *Celestial Objects for Common Telescopes.* Between January 23, 1871, and April 10, 1872, fifteen lunations, or 442 days 23 hours, will have elapsed, so that on April 10 and following days to the 18th the moon's morning terminator will pass over the objects given in our list for January, 1871, vol. IX., p. 18. It will be seen, on referring to that list, that on January 23 Supplement ☾—☉ at midnight was 142° 7′, and that this angle diminished to 52° 36′ on the 31st. On April 10, 1872, at midnight, supplement, ☾ — ☉ will equal 144° 21′, and on the 18th its value will be 55° 50′. The present month accordingly affords an opportunity for commencing a comparative series of observations of the objects given in that and the following lists.

On the 23rd of March, 1871 (see vol. IX., p. 72,) the value of ☾ — ☉ was 147° 34′, diminishing to 59° 4′ on the 31st. As these values slightly exceed the values for April 10 to 18, 1872, the lists for January and

March, 1871, combined, will not only furnish suitable objects for observation in April, 1872, but probably be the means of refreshing the memory as to interesting points previously observed.

Fourth Zone of objects from North to South.

Chevallier (*a*), Shuckburgh (*b*), Hooke, the Crater (*c*) marked *a* by B. & M., N.W. of Schumacher, Schumacher, Messala, Bernouilli Prom: Agarum, Condorcet, Furnerius, Frauenhofer, Boussingault, Boguslawsky.

This zone may be observed as the objects are coming into sunlight. They were well seen on March 13, the terminator passing through Atlas, Guttemberg, and Fabricius—the moon being seven days past perigee. Most of these objects are but little known.

(*a*) A ring W.S.W. of Atlas, named to commemorate the astronomical labours of Professor Chevallier. See *Monthly Notices* vol. XXIV., p. 19.

(*b*) A ring between Chevallier and Hooke, named in commemoration of Sir George Shuckburgh.

(*c*) Proposed name, Carrington.

Errata.—March 14, for *Sartner* read *Gartner*. March 21, for *Rosh* read *Rost.*

Errata in last No. of *Register*:—

Page 65, line 22 from top, for *Arcetic* read *Arcetri.*

Page 66, line 28 from top, for *something* read *something strange.*

Page 72, lines 9 and 11 from top, for *conjunction* read *conjunctive.*

By an announcement in our advertisements our readers will see that Mr. Browning has taken, in addition to his other houses of business, premises at the West End, No. 63, Strand, which will be a great convenience to the public. We wish him further success.

NEW MINOR PLANET.

We have received the following note from the Royal Astronomical Society:—

Discovery of a Minor Planet (118) Peitho, at Bilk. By Dr. R. Luther.

M.T. at Bilk.

1872	h. m. s.		h. m. s.		° ′ ″
March 15	14 18 59·6	R.A.=	12 7 26·73	N.P.D.=	79 42 33·5

From an observation made by Dr. Tietjen, at Berlin:—

M.T. at Berlin.

1872	h. m. s.		h. m. s.		° ′ ″
March 21	9 33 23	R.A.=	12 1 36·36	N.P.D.=	79 20 46·1

The daily motion obtained from these observations is in R.A. - 60^{s}·6, and in N.P.D.—3′ 45″.

The planet is of the 11th magnitude.

March 25, 1872.

AURORA OF FEBRUARY 4.

Observed at the Meteorological Observatory at Empoli, near Florence, by P. Liverani.

After a detailed account of the preceding phases, the writer describes the following singular phenomenon. Whilst this first stratum was moving towards the south, it was followed by other similar arches at no great distance. One of these, which from 6h. 15m. to 6h. 42m. had been considerably agitated while situated in the little bear; at 6h. 48m. passed over Jupiter, at 6h. 54m. through the middle of Orion; and at 7h. 16m. it was already in Canis Major.

There it divided itself at once into four little clouds, and losing some of its intensity of colour, disappeared by degrees, and at 7h. 40m. was quite gone. A few seconds after, the little clouds it had formed reappeared, and in less time than it takes to describe it they were seen to reunite, and to dart in all directions, jets of white light like a firework. The rays on the west and east alone remained some time, and at 8h. 12m. others appeared in number not less than ten, all which, arranging themselves on the northern side, formed as it were, a luminous fan, with its centre at B. of Orion. This novel arc, like a zenithal aurora, lasted only twenty minutes and then, gradually decreasing in size, was only entirely extinguished at about 11h. It was during this phase of our aurora that the colours of the northern zone lost some of their intensity. The meteorological state of the atmosphere presented nothing particular during the whole time of the phenomenon. There was a very light N.E. wind below, and a S.W. high up; the temperature relatively high, and barometrical pressure always increasing. We add, in the last place, that three *falling stars* were seen; one at 7h. 10m. from Vega to the near horizon, another at 8h. 25m. in the direction of Jupiter to the Pleiades; and the last at 8h. 30m. from Jupiter towards the west.

THEORY OF HEAT.

By J. Clerk Maxwell, M.A. Longmans, 1871. 3s. 6d.

If the substance had been one of those which expand in melting, the effect of pressure would be to solidify some of the mixture, and to raise the temperature of fusion. Most of the substances of which the crust of the earth is composed expand in the act of melting. Hence, their melting points will rise under great pressure. If the earth were throughout in a state of fusion, when the external parts began to solidify, they would sink in the molten mass, and, when they had sunk to a great depth, they would remain solid under the enormous pressure, even at a temperature greatly above the point of fusion of the same rock at the surface. It does not follow, therefore, that in the interior of the earth the matter is in a liquid state, even if the temperature is far above that of the fusion of rocks in ore furnaces.

It has been shown by Sir W. Thomson that if the earth, as a whole, were not more rigid than a ball of glass of equal size, the attraction of the moon and sun would pull it out of shape, and raise tides on the surface, so that the solid earth would rise and fall as the sea does, only not quite so much. It is true that this motion would be so smooth and regular that we should not be able to perceive it in a direct way; but its effect would be to diminish the apparent rise of the tides of the ocean, so as to make them much smaller than they actually are.

It appears, therefore, from what we know of the tides of the ocean, that the earth, as a whole, is more rigid than glass, and, therefore, that no very large portion of its interior can be liquid. The effect of pressure on the melting point of bodies enables us to reconcile this conclusion with the observed increase of temperature as we descend in the earth's crust, and the deductions as to the interior temperature founded on this fact by the aid of the theory of the conduction of heat. pp. 20, 21.

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JOHN BROWNING begs respectfully to inform scientific gentlemen and the public generally, that he has taken the Premises, No. 63, Strand, opposite Bedford Street. These premises he will open as a West-End branch of his business on the 18th of March. In a Show-room on the ground floor there will be every convenience for testing, or seeing in action, Microscopes, Spectroscopes, Astronomical, Electrical, and other Philosophical Apparatus. There are light workshops on the premises. Communication has been established by electric telegraph with the Factory at 111, Minories. JOHN BROWNING, Optical and Physical Instrument Maker to the Royal Society, the Royal Observatories of Greenwich and Edinburgh, &c., &c., &c., 63, Strand, W.C.; 111, Minories, E.; and 6, Vine Street, E.C. Specialities, Spectroscopes, Astronomical Telescopes, Polariscopes, Microscopes, and Electrical Apparatus.

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Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 113. MAY. 1872.

THE ECLIPSE EXPEDITION.

Lecture at the Royal Institution.

At the Friday evening meeting on March 22, 1872, Mr. J. N. Lockyer, F.R.S., delivered a lecture on the eclipse of December 12, 1871, to a crowded audience. He commenced by saying that his business was to state the results of the Eclipse Expedition, but as such results were embodied in the large pile of MS. on the table before him, he must necessarily confine himself to the observations made by himself and Sig. Respighi. He first pointed out on a map the course of the eclipse shadow, and the stations occupied by the various observing parties. Col. Tennant, Capt. Herschel, Dr. Janssen, Mr. Pogson and others having previously selected their stations, Mr. Lockyer chose Bekul, and Professor Respighi Poodocottah, both on the mainland, other detachments of the expedition being left in Ceylon, at Jaffna and Trincomalee. Only one party out of five into which the observers were divided, failed to see the eclipse. The lecturer then described the extent of our knowledge before the last eclipse, and stated that at the preceding one in December, 1870, the hydrogen lines of the corona spectrum had been seen by Professor Young extending to a distance of 8′ from the solar disc, and 1474 Kirchhoff to a distance of 20′ by the American observers in Spain. Mr. Watson's drawings in 1870, and the reversal of the Fraunhofer lines observed by Professor Young and Mr. Pye were also noticed, and Mr. Brothers' photograph taken in Sicily exhibited, which showed a most extensive corona, the rifts of which corresponded in position with the photographs taken in Spain. The great point left to be determined, therefore, was whether this extensive atmosphere of hydrogen and the unknown substance giving the 1474 line was reflected light or not.

The various instruments taken out by the expedition were exhibited and described, and a number of experiments performed with Mr. Spottiswoode's polarising apparatus and the electric lamp, to show the mode of using the biquartz and savart polariscopes, which were but partially successful. Illustrations of Professor Respighi's mode of observation were next given, in which it was very well shown that the usual form of the spectrum depended on a slit being used, and that with a crooked slit the form would be zig-zag, and with a ring aperture circles of colours would be produced, according to the nature of the elementary bodies rendered incandescent. Respighi now uses a prism in front of the object-glass of his telescope with neither slit nor collimator, and thus when the sun is covered by the moon, the constituents of the corona become visible as coloured rings. Mr. Lockyer's principal results were obtained by observing the eclipse through a powerful train of prisms, without any telescope at all, and he deduces from them that the structure of the corona appears to be that of cool prominences, and consists mainly of hydrogen and the matter of 1474 Kirchhoff. Professor Respighi, who was about 100 miles distant from Mr. Lockyer, saw in his instrument when the ordinary solar spectrum disappeared, a vivid red zone or ring and two green ones, the brightest of these latter being due to 1474 Kirchhoff, with vivid coloured jets where prominences occurred. Mr. Lockyer, using the instrument above referred to, saw the same rings with the addition of a violet one, being another of the hydrogen colours. The absence of the yellow, which is due to another element of the prominences, and which was seen when they and the chromosphere were observed, shows conclusively that the coronal light is not that of the sun or chromosphere reflected, but that for eight or ten minutes at least there is a true solar appendage or envelope, consisting of hydrogen and the unknown substance of the corona and the aurora. Mr. Lockyer then exhibited on the screen the five photographs taken by Mr. Davis at Bekul, and others obtained at Jaffna and Ottocamund, as well as drawings by Mr. Holiday and Captain Tupman. The eye drawings showed a much greater extent of corona than any of the photographs, and the structure was evidently radiated in these more distant regions. Mr. Lockyer reserved his opinion as to the reason of this extensive appearance, and seemed to have a lingering affection for a cause not exclusively solar in this outer part of the visible corona, which he hoped would be further examined in future eclipses. In conclusion, he spoke most highly of the assistance rendered to the Expedition by the late Lord Mayo, the local officials, the Peninsular and Oriental Company, the admiral on the station, and others, and expressed his deep regret at the sad catastrophe to the Governor-General which had happened since the observing party left India.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Sixth Meeting, April 12th, 1872.

Professor Arthur Cayley, F.R.S., *President*, in the Chair.

Secretaries—E. Dunkin, Esq., and R. A. Proctor, Esq.

The minutes of the last meeting were read and confirmed.

Seventy-one presents were announced and the thanks of the Society given to the respective donors. It was also mentioned that Colonel Babbage had presented a large photograph of his deceased father, and that Sir John Herschel had left 50 copies of his *Cape Observations* to the Society, in order that every person who received the Gold Medal or other Certificate of Merit might have a copy presented to him at the same time.

G. M. Whipple, Esq.,
H. Pratt, Esq., and
H. C. Levander, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

Observations of Encke's Comet: by Mr. Hind.

The places given extended from October 8 to December 6. The observations were made at Twickenham, some by Mr. Hind, and others by Mr. Plummer.

On the Orbit of the Binary Star ξ Bootis: by Mr. Hind.

The elements of this orbit were first computed by Sir J. Herschel, and afterwards by Madler. The author sent another set of elements, founded on later observations, with the predicted position and distance, for the next four years.

Mr. Hind also remarked that the recent measures of ξ Ursæ Majoris by Mr. Knott showed that the star is approaching its periastron earlier than the orbit assigned to it by Yvon Villarceau required, and that the angle for the present time, predicted by Capt. Jacob, is 26° behind the observed one. Great interest attaches to this star, as having been the first double-star orbit calculated,—Savary having been the computer.

On the Orbit of the Binary Star Σ 1398, *near* μ^2 *Bootis*: by Mr. Hind.

The elements of an orbit for this star were given, and the probable position and distance to 1876.

Discovery of Minor Planets 118, 119, *and* 120: by Mr. Dunkin.

The discovery of Peitho (118) on March 15, by Dr. Luther, has been already announced, and the elements given. An ephemeris from April 5 to 24 was now supplied.

M. de Launay announces by telegram that on April 9 Planet 119 was discovered, at the Paris Observatory, by M. Paul Henry, and the discovery confirmed next night by M. Prosper Henry. It is of the 11th magnitude. He also telegraphs that M. Borelly of Marseilles discovered Planet 120 on the 10th April. It is between 11th and 12th magnitude.

Observations of the Minor Planets Peitho (118) *and Ægina* (91), *and new Nebulæ discovered and observed at Marseilles*: by M. Borelly.

The places of the Planets were given, and also a list of six new Nebulæ, with the stars of comparison.

The author also, on 3rd November, 1871, observed a star in 0h. 17m. R.A., and 101° N.P.D., which was then between the 6th and 7th magnitude. On the 8th it was only of the 8th magnitude, on the 24th of the 10th magnitude, and continued without change to the 20th January, 1872, from which time he cannot see it at all. It therefore seems to be a new variable star.

On the Solar Eclipse of December 12, 1871: by Mr. Tebbutt.

The author's health not allowing him to go from Paramatta to Cape Sidmouth with the Eclipse expedition from Victoria and New South Wales, he availed himself of the instruments at Windsor to view the partial eclipse. The evening before the eclipse day was cloudy, so that he could not obtain any time observations, but on the morning of the 12th he observed some transits. A strong N.W. wind was blowing, and broken clouds passing, but they did not cross the sun, which continued clear. There were several spots on the sun, but none very remarkable. The time of first contact was given subject to a slight uncertainty, and the periods at which the principal spots were bisected by the moon's limbs. For some time the sun's limb was particularly steady, but afterwards "boiling" began. The mountainous peaks and ranges on the moon's limb were never better seen. The solar cusps were sharply defined, without any rounding of the points. The most interesting observations were those of the thermometer in vacuo in the sun's rays. This fell continuously to the greatest obscuration, then rose again to the end of the eclipse, when it began to fall from the sun's decreasing altitude. A table was given of the readings, showing a fall from 114° to 106°, whence it again rose to 113°, ultimately falling to 93°.

On the Proposition 38 *of the* 3*rd Book of Newton's Principia*: by Mr. Todhunter.

This was an important mathematical paper on Newton's discussion of the moon's figure, which was necessarily taken as read. It was also connected with the preceding proposition, in which the figure of a fluid earth acted on by the moon and rotation is examined by Newton.

On the Insufficiency of existing National Observatories: by Col. Strange.

The author starts by quoting the Astronomer Royal's words in his recent paper on the devotion of a special observatory to observing Jupiter's Satellites, viz.:—"The position which the Royal Astronomical Society holds in the astronomical world may well justify it in employing its judgment and its influence in the direction of astronomical enterprises exterior to its own body." Adopting this view, and on further consideration of existing national observatories, the author finds that they were organized at a time when the objects of astronomy were few and well marked out. Thus the Royal Observatory was established in the interest of navigation, and although this object is now most liberally interpreted, it is impossible for Greenwich to follow up the numerous branches into which the science has ramified; besides which, it is not adapted for researches on the Physics of Astronomy. Greenwich may be taken as the type of endowed observatories, for, according to the annual report of the Society, there is at the other principal observatories nearly a total absence of physical research. Greenwich adheres to meridional observations, and this devotion has been productive of incalculable gain to science, and must have been pursued at the cost of great self-denial to the director who has felt compelled to resist other and more attractive objects. The author desired to raise the question whether official bodies cannot be got to take up some of those important subjects which now claim attention, and if the Government were not to be moved, whether the Astronomical

Society, or similar bodies, could not do something, and that without at all checking the zeal of private observers. All researches which require long-continued observations should be carried on at some official establishment. The labours of private individuals are liable to be interrupted by their deaths or the loss of the possession of the observatory. Individuals might strike out new fields of research, as in the case of solar physics, but this had now become too large a subject for private observers. The mapping of the moon, again, was too heavy a work for individuals, it required co-operation and assistance, or it would never be completed. The subject being thrown out for discussion, he would suggest that the systematic observation of the sun should be taken up by the Government. Changes in the sun were evidently closely connected with the climate of the globe, and, looking to the importance of this to agriculture and other pursuits, he knew of nothing that promised so much benefit as the study of the sun he advocated. The subject required immediate attention now, for two reasons:—the first was, that the photographic study of the sun spots carried on at Kew by Messrs. De la Rue, Balfour Stewart, and Löewy was about to be closed; and the other was, that a Royal Commission on scientific education and the advancement of science had been sitting two years, and had reported on the first branch of its enquiries, and was now considering the second subject, and no doubt the conclusions of that body would govern the mode of advancement of science for a long time to come.

The Astronomer Royal said: I have heard the various papers read to-night, and remarked several points in them upon which I will offer a few comments. With respect to eclipses, great attention is often paid to obtaining the times at which certain spots are covered and uncovered. It is a common feature of eclipse reports, but nothing has ever come of it, and I recommend that it never be done again. One matter connected with the late eclipse is of a most important and gratifying character, as showing the perfection of the arrangements of Society for communicating valuable information in a wonderfully short space of time. This eclipse took place in India in the morning; by noon I had received, by way of Teheran and Tiflis, very good accounts of the results, which were sent to the evening papers, and thus published in London within a few hours of the event occurring on the same day on the other side of the globe. With respect to Mr. Todhunter's paper, I am delighted that a man of his ability and leisure should have taken up such an important portion of Newton's immortal work. Both La Place and Plana have remarked the importance of the discussion contained in these two propositions, and have noticed the correctness of Newton's results as compared with those of much later time. Professor Adams and I have talked over these methods, and observed that they are nearly identical with those of Gauss, and that the latter, with more correct data, obtained results very little superior in accuracy. It is, therefore, a striking instance of the wonderful sagacity of Newton, that, with his more troublesome method, he should in the *Principia* have anticipated the results of the best modern analysis. Turning to the paper of Col. Strange, I may observe that I have gone over the histories of most observatories, and have had more to do with organizing and arranging the constitution of many such places than any other person. From this work I have arrived at a general impression for which I can hardly give any sufficient reason, but which is, nevertheless, strongly impressed upon my mind, that no observatory can ever sustain its position unless it is connected with some secular object. Greenwich would never have existed and reached the state it is now in, if it had not been rigorously connected with navigation. The inscription over the door and the warrant appointing the Astronomer Royal insist on this connection, and point out the promotion of navigation and the determination of terrestrial longitudes as the objects of the establishment. I have, therefore, always kept this special and secular object in sight. I and my predecessors have devoted ourselves to observing the moon, not for the sake of improving the lunar theory, but for its use in obtaining longitudes, and even the altazimuth, which has done so much for the theory, was set up for this purpose also. There are two other methods by which I have sought to promote the objects of the Royal Observatory, and these are by encouraging the improvement of chronometers, for which I believe I am most favourably looked upon by the makers of those instruments; and by the dissemination of time signals, in which I am anxious to go farther than the Government will sanction. I therefore think that an observatory can never stand without some useful object, not only to prevent astronomers going mad, as they have been apt to do since the time of Flamsteed, and hence the institution of the Board of Visitors, but because Governments want to have something to show for their money. I remember talking to an old friend, a man of sound judgment and excellent sense in most matters, about my experiments on the variation of gravity in a coal mine, and mentioning that, although I provided for most of the work myself, the Government had given me some assistance towards the expense, and he asked me how much I got. I said 100*l*. Then, said he, I protest against being taxed for my share of that sum. So that you see it is not every one in the kingdom who sees the necessity of these scientific operations as Col. Strange does.

Dr. De la Rue: I am desirous of making a few remarks on the valuable communication of Col. Strange. It is known to you that, besides the work carried on at Greenwich, to which allusion has been made, there are other observations of an utilitarian character conducted in establishments supported by Government; I refer to the meteorological observations; it appears to me that observations of the Sun could be most properly undertaken at one or two of these establishments as part of their daily work. For it cannot be denied that even small variations in the amount of solar radiation must affect oceanic and atmospheric currents, and other terrestrial phenomena which act upon climate; hence it is of the utmost importance that the changes which are going on in the primary source of light, heat, and actinic force should be ascertained with accuracy. My experience in photographic observations of the sun, during the last ten years, has led me to believe that there is no other method comparable with it as to accuracy, facility, or economy, and I hope most sincerely that before long there may be established a sufficient number of observatories in the British Dominions in different parts of the globe to ensure a photographic picture of the sun on every day of the year.

That the Government attach great importance to meteorology may be inferred from the amount annually placed at the disposal of the Meteorological Department under the Board of Trade, namely, 10,000*l*. This money is administered, under the direction of a committee nominated by the Royal Society. They have organised seven principal observatories in England, Scotland and Ireland, where records are made by automatic instruments, and also several secondary stations where eye observations are made. The data collected at 8 a.m. from these, and several stations on the Continent, are discussed, and the results posted up in London by 2 p.m., and sometimes a drum is hoisted on the coast when there are indications of a storm travelling in that direction.

At present nothing more is done to place meteorology on a truly scientific basis; we are simply collecting a vast mass of data from which, in process of time, we may be able to trace upwards the laws which produce the perplexing variations in climate. By proceeding in the way we are doing, some centuries may elapse before it will be permitted to disentangle from local causes, the effects produced by cyclical changes in the amount of solar radiation. Local operations, such as cutting down or planting trees, the drainage of marshes, and the land generally, and other works, play an important part in inducing climatal changes, but I believe that the main cause of variations in the weather at particular seasons rests with variations of solar radiation.

It appears to me to be an easier process first to study the cyclical changes of the sun, and then to trace out step by step the connection of their influence on climate.

The expense of a photographic observatory, where pictures of the sun could be obtained, and there measured and discussed, would be about 400*l.* per annum. The expense is really so small that I think it should be strongly impressed on the Government that there is a necessity in the interests of meteorological science for getting at least one picture every day at some place within the British Dominions, in order that the continuity of the operations may never be interrupted by the weather. Not only should spots be studied, for probably they are not the most important features, but the faculæ also which are of great consequence. The study of the sun should also include spectroscopic observations of the prominences if possible. The Government should, therefore, be urged to take up and continue the labours which have hitherto been conducted at Kew, these having now been brought to a close. It would be quite possible to publish with the daily weather report a record of the sun's activity on the day of publication. I must add that I for one feel much indebted to Col. Strange for his very suggestive paper.

Mr. C. V. Walker: Hearing the Astronomer Royal refer to time signals, I may mention that the last official thing I did to-day was to answer an enquiry from the Government on this subject. Mr. Airy will remember requesting me to co-operate with him in giving time signals to the Horological Institute in Clerkenwell, the centre of the watch and clock trade, and I have been asked to-day whether it is desirable that these signals should still be allowed to be sent at the public expense, as it is suggested they are merely used for trade purposes. The Astronomer Royal was fully impressed with the importance of supplying time to this district, and it took us twenty-eight months to get the matter arranged. I have to-day read over the voluminous correspondence and papers on the subject, and have replied to the Government that, as far as I am aware, it appears to me entirely a matter of public interest, and not a matter of trade, or we should not help to carry it out. We felt it a matter of benefit to the public, and assisted in sending the signals from Greenwich with the greatest pleasure. I therefore quite hope that the time will still be sent.

Professor Selwyn said, that although Dr. De la Rue's series of sun pictures was about to close, his own little series would continue for the full term of eleven years, of which nine only had now expired. Of course, the continuance would depend on the speaker's life lasting so long. The period of eleven years had been fixed upon by the advice of Sir John Herschel, who always urged that the pictures should be taken for that time, so as to include a complete spot cycle. Before sitting down, he wished to call attention to an extraordinary instance of the prescience and sagacity of Sir J. Herschel, who had pointed out the analogy of sun spots and cyclones, and referred to a possible cause of the former in currents of heated atmosphere, moving from the solar equator to the poles, combined with the rotation on its axis. Now, in the last number of the *Astronomische Nachrichten*, there was a paper by Secchi, giving the record of 2,000 prominences, in which this theory was confirmed by ocular inspection, the direction of the prominences showing currents from the equator to the poles, and also some in the reverse direction.

The Astronomer Royal said he thought the term employed by Secchi for these remarkable appearances was *penaggio*. They were of a flag-shape, arising to a certain height, and then being driven out horizontally. The form was that which he had designated the *boomerang* at the eclipse of 1851, a term which has been generally adopted since. Secchi's table showed that in about three-fourths of the number the direction was from the equator to the poles, but sufficient information was not given as to the elevation above the sun's limb. He would also remark, with respect to Mr. Walker's statement about time signals, that if it had not been for Mr. Walker there would not have been a signal sent anywhere through England at the present time. The South-Eastern Railway Company allow the wires to run from Greenwich Observatory to their line, and keep up the wires and poles; and how much did the Meeting suppose was paid for this assistance? When arranging the service he stipulated that their rights should be fully recognised in a tangible way, and the Company charged *five shillings* a year. Such an instance of liberality and interest in science was worthy of record. With regard to the general question commented on by Dr. De la Rue, he (Mr. Airy) considered the office of bodies paid by, and supported and kept in order by Government, was very simple. Such a body could not go groping about for the causes of solar changes, such as planetary conjunctions and the like, but must occupy itself in making definite series of observations. He, therefore, could not go so far as was desired by previous speakers. Of course, if Dr. De la Rue and his friends could point out any definite series of observations to check a theory of cause and effect, then a Government observatory might be employed for that purpose, but at present he thought it was the place of a Government not to establish philosophical institutions, but working bodies.

Col. Strange said, in reply, the Astronomer Royal has stated that no observatory should be started without a secular object. This has been hitherto very much the case, not because only those having such objects lead to good results, but because those not making such appeals are not appreciated. The Government is not remarkable for scientific knowledge, and the nation is absolutely destitute of science, because it has not had the teaching requisite for carrying out objects unintelligible to the ignorant. But here I am not addressing ignorant persons, and those who are insensible to any but the *cui bono* argument. Nature will not be so treated. We shall attain no great object unless we go to a fresh school; otherwise we shall infallibly make blunders. The vital defect of English science is its want of completeness. From their unhappy state of ignorance the people want something they can count. Hence we build a British Museum. I have a great respect for the British Museum, but it costs 100,000*l.* a-year, and the people go there only to see the stuffed monkeys. The Government is ignorant, and the people more so if possible. Whose business is it to teach them? We must teach them to understand that not only is the thing good in an intellectual sense, but that in time it will bring forth utilitarian results likewise. This is why I dwell in my paper upon the necessity for the study of our great luminary, as nothing can be more calculated to influence the material prosperity of the people. I may even turn round upon Mr. Airy, and say that, had he been true to his principles, and stuck only to the direct improvement of navigation, he would never have been at the head of the great establishment he directs, and which is truly a great philosophical institution.

Capt. Toynbee desired to acknowledge the great advantage he had derived from the use of "lunars." Often he might have lost a ship but for their aid. With regard to the sun, surely enough has been done by private men to induce the Government to take it up. If meteorology would gain in the manner Dr. De la Rue had referred to, by an investigation of the solar changes, a case had been made out which required every attention by our rulers.

The Astronomer Royal said Capt. Toynbee had very well put the proper plan of proceeding. Take Greenwich as an example. At its origin the theory of gravitation was pretty well established; then arose a commercial want of places of the moon for the service of navigation, and the question was whether an institution could not be started for using this theory of gravity. It was perceived that a most extensive series of observations of the moon and stars was necessary, and the Observatory was set up. It was quite correct to say that any other subject has the same claim to beattended to as the moon, now that the latter is pretty well done with; and much other work is, in fact, now carried on at the same time at Greenwich. If theory or antecedent observation show a worthy object, the necessary investigation should be sanctioned.

On the Law of Facility of Errors of Observation and on the Method of Least Squares: by Mr. J. L. W. Glaisher.

The author read a portion of the historical introduction of this paper, and explained his mathematical views by formulæ.

Second Part of a Memoir on the Development of the disturbing function in the Lunar and Planetary Theories: by Professor Cayley.

The author explained that the former part of this memoir had been written in 1859, and that he had not completed it until now.

Mr. Browning exhibited *Photographs of the late Eclipse* mounted stereoscopically, which showed the moon standing out in front of the corona. The photographs had been placed at his disposal by Lord Lindsay, having been taken at Bekul by Mr. Davis at Lord Lindsay's expense. Mr. Browning considered they showed the structure of the corona better than any other photographs, although it was not so extensive as in Mr. Brothers' negative, taken at Syracuse in 1870.

Dr. De la Rue having examined the stereograph, said that in 1860, when he photographed the eclipse in Spain, he combined some of the pictures stereoscopically, and obtained the same result, but with a further effect, which was not apparent in the pictures now exhibited. In these the moon looked a black disc, standing away from the light coronal background, but in the Spanish photographs the moon was strongly projected in a globular form which he could not see here.

Mr. Ranyard doubted whether these were real stereoscopic effects, or produced by contrast of light and shade. He thought the motion was too small during the eclipse to produce pictures adapted for the stereoscope.

Dr. De la Rue said Mr. Ranyard was mistaken, as the motion in the time was quite sufficient.

Mr. Ranyard: There are so many ways of producing a stereoscopic effect that we should be quite sure on this point.

Mr. Proctor said no one would suspect him of wishing to invalidate evidence of the corona being solar, but he must say that, when combining Mr. Brothers' photographs, if placed in one way the moon appeared stereoscopic, and in another mode pseudoscopic. The argument from the stereoscopic effect was not a very strong one.

Mr. Brothers said, that when, twelve months ago, he exhibited a stereoscopic view of the eclipsed sun, he observed that the same thing could be done with diagrams of circles white and black. He had considered his pictures as an evidence that the corona was a solar appendage, but a gentleman of eminence had denied this.

Mr. Brothers also exhibited the original negative of 1870, which had not before been shown at the Society, and an enlarged drawing from it. By careful examination, the corona, looked at by reflected light, extended 2⅓ diameters on one side of the sun.

The meeting then adjourned.

COMETS.

Professor Donati writes in the *Nazione* of March 4 in reference to many inquiries made of him respecting the announced collision of a comet with the earth in August next. He remarks, that at present, there are no comets visible, and that the appearance of large comets would be welcome, since there are recently discovered means of making new researches on them. He goes on to speak of the comet of Biela, due in August next, and inquires whether it may at some future time encounter the earth; and states, as the result of calculation, that this comet will be in 1872 always at a great distance from the earth. It will cross the earth's orbit on August 26, at which time it will be about 110,000,000 of geographical miles from the earth. This will be its nearest approach. On November 28, the earth will be situated where the comet was on August 26. There is therefore no danger of a collision with the earth. The professor then points out the extreme improbability (*il possibile degli impossibili*) of the earth colliding with *any* comet; or, if such a thing were to happen, the comet, he remarks, might probably become a satellite of the earth. He observes that in 1832, there was a similar report of a coming collision with Biela's comet, and that in spite of the assurances of astronomers, the general panic did not cease till dispelled by the actual falsification of the prophecy. Donati proceeds to comment on the very great probability, that the comet of Biela, which has not been seen since 1852, no longer exists, (the figures given above are on the contrary hypothesis.) In 1846, (as is well known), it appeared *double*, its two parts being 134,000 of geographical miles from each other; and in the apparition 1852 they were 200,000 geographical miles apart. The comet not being seen in 1858, was attributed to its nearness to the sun, as in 1839; but in 1866, when it should have been visible in dark night, the most powerful telescopes failed to discover it.

What then is become of the comet? has it vanished, or changed its course? That comets might be dissipated was long ago supposed by Kepler, who said that as the silk-worm wastes itself by spinning its cocoon, so comets may waste themselves and *die*, whilst they generate or *spin* their immeasurably long tails.

Besides Biela's comet, another discovered by Professor de Vico at Rome in 1844, which should return every five and half years, has not been seen since; yet this comet was much larger than Biela's, and did not, like the latter, show itself double. What may become of comets which disappear? Newton imagined that comets either fell into the sun, or scattered their matter through the celestial spaces, and thus served for aliment to the sun, and to the planets also. Nor, indeed, is this hypothesis of Newton's unreasonable, for although as I have remarked, the chance is very small that the comet of Biela should encounter the earth, I further observe that it may well be that its matter has already in part fallen, and is still falling upon our planet. . . . . In evidence of this, Donati goes on to refer to the recent investigations of many learned men, and, in particular, of Professor Schiaparelli; who, on this account, obtained this year's gold medal of the R.A.S. of London. . . . . Professor D'Arrest has observed that the falling stars of the 5th December, radiate from the part of the heavens where the comet of Biela would appear, if in the beginning of that month it were to be in the neighbourhood of the earth. It appears then indubitable that this comet also forms part of a band (*armilla*) of cosmical corpuscules which revolve round the sun, and that in fact, it is only the largest of the said corpuscules. If this be the case, it would be subject to a mechanical action from those little bodies amongst which it is situated; and this action may have been the actual cause of the division into the two parts witnessed in 1846 and 1852. Similar divisions may have subsequently reduced the comet into fragments so small, that they only appear like falling stars, when in December, the earth approaches the band in which these little fragments move. Hence, as I remarked, perhaps the substance of the comet of Biela has already, in part, fallen to the earth, and may yet continue to fall upon it. But in all this there is nothing to cause apprehension, since the corpuscules that, whilst they are burning, appear to us as the falling stars, are in general consumed in the higher regions of the air, and only in very rare cases reach the surface of the earth under the form of the bodies called *aeroliths*. My supposition that Biela's comet may have been broken up into those little bodies which generate the falling stars, would acquire additional likelihood if, in August next, astronomers should not succeed in seeing this comet, as was the case in 1866. I have treated thus at length on the comet of Biela, because I have not been able to find any other astronomical indication that could in any way account for the general report of a coming collision between the earth and a comet in August next. Nevertheless, this common belief may perhaps be owing to reasons quite other than astronomical, inasmuch as error insinuates and spreads itself much more readily than truth.

Royal Observatory of Florence:
March 2, 1872.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

CUI BONO?

Sir,—May I be forgiven for saying that the letter of "R. E. J." on p. 71, is simply irrelevant to the question raised in the communication which you did me the honour to print in the January number of *The Astronomical Register*?

I believe that I appreciate simplicity of explanation at least as much as "R. E. J." can possibly do; but I confess that I utterly fail to find it in the Denning-Waite rigmarole which I criticised. I took no particular exception to the "ordinary sized marble" form of expression, although it did seem to be modelled upon the idea of magnitude entertained by the witness at the Old Bailey, who stated, on oath, that the stone thrown by the prisoner in the dock was "as big as a piece of chalk." It was the utter vagueness and incoherence of the entire statement (vagueness and incoherence which deprived it of any scientific value whatever) that I found fault with.

Whether "R. E. J." has not enough mathematics to understand how the angular subtenso of a telescopic field can be 1° 7′ 42″ (which he need scarcely be either a Cayley, Hirst, North, Sylvester, or Todhunter to do), or whether his confidence in the law of gravitation is so shaky as to preclude him from believing that the places of the planets can be calculated back for four thousand years, is a little wide of the mark. Perhaps I shall best point out what his admiration for Mr. Waite's form of exposition leads to by assuming, by way of illustration, that your correspondent were to wish to know when the meetings of the Royal Astronomical Society are held? Were the question put to me, I should answer, "On the second Friday in every month, from November to June inclusive." This, however, would be too bald, direct, and naked a statement for him; and, if he be consistent, he would prefer to be informed, *more Waitei*, that "The Society meets during two-thirds of the year, which must comprise either summer, autumn, and winter, or winter, spring, and summer; or else, perhaps, autumn, winter, and spring; unless, indeed, it should happen to be spring, summer, and autumn: and that the meetings take place either during the first or last halves of the months; and that, if they are not held either on Monday, Tuesday, Wednesday, or Thursday, they certainly are either on Friday or Saturday."

If any one will take the trouble to turn back to p. 287 of your last volume, I would really ask, with some confidence, whether this imaginary reply is a material exaggeration of the Denning-Waite mode of diction? and should really like to know whether this is the kind of mental pabulum that "R. E. J." craves, and is so desirous to be supplied with through the columns of *The Astronomical Register?* I am, sir, yours faithfully,

March 7, 1872. A SUBSCRIBER.

OBSERVING-SEAT.

Mr. Knobel writes to state that the *Handle* on the shaft of the Observing Seat, in our April Number, has been introduced in error by the Engraver, and has no real existence. There is no handle and none is necessary.

TRANSIT OF JUPITER'S FOURTH SATELLITE.

Sir,—On April 8 the satellite traversed a bright streak just *s* of belt 6, and was never more than one-fifth of Jupiter's diameter from his S. pole. Air very clear, and fairly steady. With 212 on 9-inch "With-Browning" IV. before ingress was small and brownish as usual. Before it was fully on the planet the advancing side became invisible, a circumstance I have never before observed. And it was actually beginning to be dark when only half its own diameter clear of the limb of Jupiter. When one diameter clear it was easily seen, and was larger, nearly equal in size to I. then just *f* Jupiter. At two diameters clear—still darker. At 9·20, when about 7″ from the nearest limb of the planet it was quite *black*. I could then see two slight projections, E. and W., and I thought between these, and completing a circle, there was a border with a slightly darker tint than the background. There was no perceptible change in the appearance of the satellite up to 10·20—past mid-transit, and near the noon of Jupiter, where we expect his surface is the most luminous. At 9·40 the *black* spot was less than I., which commenced its transit a few minutes before. I am, Sir, yours truly,

Bonner's Road, Victoria Park: T. H. BUFFHAM.
April 13, 1872.

TRANSIT OF JUPITER'S SATELLITES I. AND IV.

Last night these were on the disc together from 9-10 to 11-30 Local Mean Time.

There was this striking contrast between the two, that whereas I. was during the whole time utterly invisible, so that its place could not even be guessed at, IV. was seen during the whole time of observation, as a well-defined, almost entirely black spot, much smaller than I should have expected.

When first IV. was observed, it had accomplished one quarter of its journey across the disc, and it was watched till within the same distance of its egress.

During the first half of its journey it appeared both blacker and better defined than during the latter, the air being equally good the whole time. This transit took place along the S. edge of a dark belt.

My friend, Mr. Charles Burton, drew attention to the fact that the dark spot representing IV. was not round, but decidedly elongated in the direction of the belt during the whole time of observation. In this I concurred. Powers used were 150 and 400 on my 7½-inch Alian Clarke.

On 31st March, I observed transit of III. also as a dark body smaller than expected.

On 9th March, I observed a transit of I., on which occasion also it was to me utterly invisible.

WENTWORTH ERCK.

Sherrington Bray: April 9, 1872.

Addendum to note by Wentworth Erck, Esq., on Transit of Jupiter's Satellites I. and IV. of 8th April, 1872.

The satellite's following extremity was sharper than the preceding, 11-30 L. M. T., power 400.

Loughlinstown: April 10, 1872. CHAS. E. BURTON.

Note on Transit of IV. Dec. 30, 1871.

IV. When first seen, taken for a satellite shadow on account of its blackness.

I could not satisfy myself that IV. was not circular. When first seen, and not more perhaps than its own diameter from the planet's limb, the satellite was extremely dark, possibly as dark as when near mid-transit. I once or twice thought that the satellite was in contact with a bright crescent on its s. p. limb. (This bright crescent was, very possibly, part of a white spot on the planet.)

At 12-20 L. M. T., the satellite was in close contact with the N. edge of Gledhill, No. 6. High wind, definition fairly good, at times bearing 228.

Instrument used, a 7-inch silvered glass Newtonian, equatorially mounted, with R. A. driver.

CHARLES E. BURTON, late of the Observatory, Parsonstown; and Member of Eclipse Expedition, 1870.

PROCTOR'S STAR CHART.

Sir,—It would be interesting to hear from Mr. Proctor some account of the peculiarities shown by his star chart of the northern hemisphere. In the copy I have—and doubtless all are the same—there are some features which, I suppose, are due to accident in drawing the original. The chief of these is the manifest tendency of the stars to a concentric arrangement round the pole. For example, there appear to be rich regions in Auriga in dec. 40° and 45°, and in Cygnus in 53°, and blank regions in Cassiopeia in dec. 51°, and Camelopardus in 65°. There is also a slight radiation from the pole, especially between 0h. and 2h. in R.A. The texture of the map, as Mr. Proctor points out, is very remarkable, showing a strong tendency of the stars to arrange themselves in minute lines, so forming a network. I suppose this is correctly drawn.

I am,
Yours, &c.,
T. W. BACKHOUSE.

Sunderland : Feb. 14, 1872.

FINE METEORS.

Sir,—An unusually magnificent meteor was observed here on March 31. The following positions, &c., may be considered pretty accurate. First appearance, R. A., 6h. 40m., Decl. 33°; time, 12h. 9m. It first presented no extraordinary appearance, but soon became much larger and brighter, illuminating the whole of that part of the sky. Its colour was at first white, then red, then an intense purple. It was still rapidly increasing in size and brilliancy, when, unfortunately, a house cut off all further view of it. Its position then was about R. A., 9h. 0m., and Decl. 0°. Duration of visibility, probably not more than one second. It left no train.

Between 11h. 40m., and 13h. only two others were seen. These, however, were ordinary "shooting stars:" the direction of their motion was from the same radiant point, but towards α Tauri.

Yours faithfully,
Barnsbury, N.: April 4, 1872. F. W. LEVANDER.

Sir,—A fine meteor, with a long and persistent train, was observed here at 7h. 55m., G. M. T. on the evening of March 26. It proceeded from about midway between η *Ursæ Majoris* and γ *Bootis*, and disappeared very near to β Cephei. Its colour was orange, and it seemed to be at least equal to Jupiter in brightness.

I remain, yours faithfully,
Bedford: March 28. THOS. G. E. ELGER.

LINNE.

Dear Sir,—I had a very fine view of Linne on the 15th of March last, about 9h. G. M. T. I am induced to communicate this, as I think I saw the crater quite as distinctly and sharply defined, though not quite so large, as it is represented in Mr. Carpenter's beautiful drawing in No. 70 of the *Register*, October, 1868. This drawing represents the appearance in the Greenwich Equatorial of 12¾ inches aperture on June 26, 1868, at 10h. G. M. T. The crater arose out of the hazy white cloud, as a low conical hill, with exactly the appearance depicted in Mr. Carpenter's drawing. By a fortunate coincidence, the moon's age was almost precisely the same in both cases, being in Mr. Carpenter's 6·3 days old, and in mine 6·37 days. The instrument used was a very fine refractor of 8 inches aperture, by Cooke and Sons, recently erected here, with a magnifying power of 550. The definition was exquisite, as I first distinctly saw the minute crater with so low a power as 135.

Yours truly, GEORGE HUNT.

Chad Road, Edgbaston : April 13, 1872.

THE HOLLIS OBSERVING-SEAT.

Sir,—Will you allow me to call the attention of your readers to the "Hollis Observing Seat" recently advertised in this paper. I find it a most valuable addition to my 3in. Achromatic : indeed for use with small telescopes of this sort, it is really the best I have yet seen, and its price is almost nominal.

It is only suited to direct-vision Telescopes, but for them it is invaluable for besides being very comfortable, it affords a steady support for the head of the observer. OLIVER J. LODGE.

Errata in No. 112, page 90, 12th line from bottom, for *fitted* read *filled*; page 98, line 28, for OF THE ROYAL, read AND

Errata, page 94, at commencement, read, I have *not* been enabled; 10th line, read, the *shadow seemed* smaller and darker.

SPIDER-WEBS IN TELESCOPES.

Sir,—The remarks of Capt. Noble induce the thought that these little creatures have been unusually active of late. Having suspected a diminution in the light given by a 4-inch object glass, I brought the matter to test one evening before daylight was quite gone, by exchanging an eye-piece from it to a smaller instrument, when my suspicions were confirmed, the smaller giving by far the brighter image of the moon. An inspection of the tube was then made, by looking up at the object-glass without the intervention of an eye-piece. There was nothing remarkable in the view, but a sort of watered silk appearance over the object-glass; this was taken out and cleaned, and I was about to replace it, when happily I thought of looking through the tube alone; there still was the same appearance, which, on closer inspection, proved to be a very fine web, spun in the middle of the tube, and covered with fine dust. This was soon removed, at the same time pitying the poor spider in its effort to exist by fly catching in such a barren place.

It is not only in astronomical matters that the cobwebs and dust of earth obscure our view of heavenly things, but the practical lesson for those who delight to use these tubes armed with their wonder-working glasses, is sometimes to take a peep through them without their aid.

Yours truly,

3, Circus Road, St. John's Wood. NATHL. E. GREEN.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MAY, 1872.

BY W. R. BIRT, F.R.A.S., F.M.S.

By employing the period of similar phase of 442 days 23 hours, between February 21, 1871, and May 9, 1872, we can use the list of lunar objects inserted on p. 48 of Vol. IX., supplement ☾ — ☉, 1871, February 21,

= 150° 37′, diminishing to 73° 5′ on the 28th. 1872, May 9, supplement ☾ — ⊙ = 152° 7′, May 16 = 74° 59′. These quantities being accordant as to nearness of value with those given in our April number, the list for February, 1871, will be available for May, 1872.

On the 21st April, 1871 (see vol. IX., p. 102), the value of supplement ☾ — ⊙ was 155° 38′ diminishiug to 78° 17′ on the 28th, and still further to 53° 45′ on the 30th. The lists of February and April, 1871, may consequently be combined for indicating suitable objects for observation in May, 1872.

Libration will in a measure affect the positions of the objects given as regards the terminator. It is a matter of congratulation that in addition to the position of the terminator, the *true* method of expressing the moon's libration is given in the number for April, 1872, viz., the latitude and longitude of the centre of the visible disk, as seen from the centre of the earth. At the times of first and last quarter, when supplement ☾ — ⊙ = 90°, the objects situated near the terminator are as follows: between the first meridian and 5° west longitude, and the equator and 5° north latitude, *Triesnecker*, *Rhæticus*, *Murchison*, and the objects in my catalogue of area I. A alpha. Between the same longitudes and the equator and 5° south latitude, *Reaumur*, and the objects of IV. A alpha of my map, on the eastern side within the same limits, *Pallas* and *Herschel.* Some of these by the effect of libration may be on the night side and invisible when the moon is in her first or last quarter.

The following may be added to the list of February, 1871: Feb. 24, Römer, Maraldi. Feb 28, Pico.

Fifth Zone of objects from North to South.

Geminus (*a*), Buckhardt (*b*), Cleomedes, Mare Crisium, western part, Azoul, Firmicus, Apollonius, Langrenus, Vendelinus, Petavius (*c*).

This zone contains some of the finest formations on the western hemisphere. From their proximity to the limb they are, however, comparatively but little known. Beyond the striking features manifested by the large formations Langrenus and Petavius, the details have been but partially studied. The early spring months is the best season for observing them, and every advantage should be taken for this purpose when the moon is from two to five days old.

(*a*) The *semi-obliteration* of this crater, as the sun attains a considerable altitude, is an interesting subject for study during the progress of the luni-solar day.

(*b*) Notice the curious superposition of a recent crater on a more ancient one.

(*c*) An enlarged drawing of Petavius by Mädler, with the Dorpach refractor, is given in the new edition of B. & M.'s map.

ECLIPSE OF THE MOON.

A partial eclipse of the moon, visible at Greenwich, will take place on the 22nd of May.

	h.	m.
First contact with the penumbra	9	9·8
First contact with the shadow	10	40·9
Middle of the eclipse	11	18·2
Last contact with the shadow	11	55·5
Last contact with the penumbra	13	26·6

Magnitude of the eclipse (moon's diameter = 1) 0·116.

ASTRONOMICAL OCCURRENCES FOR MAY, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Jupiter
Wed	1		Sidereal Time at Mean Noon, 2h. 38m. 52·87s.	1st Tr. I. 2nd Sh. E. 1st Sh. I. 1st Tr. E.	9 52 10 40 11 5 12 11	— 5 0·6
Thur	2			1st Ec. R.	10 35	4 57·2
Fri	3		Sun's Meridian Passage, 3m. 19·44s. before Mean Noon	1st Sh. E. 4th Oc. D.	7 54 12 28	4 53·8
Sat	4					4 50·5
Sun	5	8 48 14 44	Conjunction of Moon and Venus, 2° 30′ N. Conjunction of Moon and Mercury 0° 51′ N.			4 47·1
Mon	6			3rd Tr. E. 3rd Sh. I.	9 13 10 30	4 43·8
Tues	7	1 18·7 5 9 22 52	● New Moon Conjunction of Moon and Mars 2° 13′ N. Conjunction of Venus and Mercury, 1° 59′ S.			4 40·4
Wed	8			2nd Tr. I. 2nd Sh. I. 2nd Tr. E.	8 1 10 21 11 50	4 37·1
Thur	9			1st Oc. D. 1st Ec. R.	9 2 12 30 28	4 33·8
Fri	10			2nd Ec. R. 1st Tr. E. 1st Sh. E.	8 3 42 8 39 9 49	4 30·5
Sat	11					Moon. 3 12·5
Sun	12	6 59 8 10 13 54 19 58 3 50	Occultation of B.A.C. 2514 (6½) Reappearance of ditto Conjunction of Moon and Jupiter, 3° 1′ S. Conjunction of Moon and Uranus, 3° 12′ S. Conjunction of Mars and Sun	4th Sh. I.	7 54	4 2·8
Mon	13			3rd Tr. I.	9 55	4 52·1
Tues	14					5 39·9
Wed	15	4 5·6	☽ Moon's First Quarter Illuminated portion of disc of Venus 0·958 Illuminated portion of disc of Mars 1·000	1st Tr. I.	10 46	6 26·0
Thur	16		Saturn's Ring: Major Axis=39·81″ Minor Axis=15·55″	1st Oc. D.	11 1	7 10·8

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Moon.
Fri	17	 8 5 9 20	Sidereal time at Mean Noon, 3h. 41m. 57·77s. Occultation of ν Virginis (4½) Reappearance of ditto	**3rd Ec. R.** **1st Tr. I.** **1st Sh. I.** **1st Tr. E.** **1st Ec. R.** **1st Sh. E.**	8 6 37 8 18 9 24 10 37 10 38 30 11 44	— 7 54·9
Sat	18			**1st Ec. R.**	8 54 40	8 39·1
Sun	19	 9 15 10 25 10 8 11 20	Sun's Meridian Passage, 3m. 45·06s before Mean Noon Occultation of 65 Virginis (6) Reappearance of ditto Occultation of 66 Virginis (6) Reappearance of ditto			9 24·5
Mon	20	8 28 9 8 14 54	Occultation of κ Virginis (4½) Reappearance of ditto Occultation of 2 Libræ (6)	**4th Oc. D.**	7 51	10 12·3
Tues	21	9 15	Near approach of ν^1 Libræ (6)			11 3·6
Wed	22	11 8·3 9 26 10 34 9 52 10 59 13 13 14 24	○ Full Moon Eclipse of the Moon Occultation of ω^1 Scorpii (4) Reappearance of ditto Occultation of ω^2 Scorpii (4½) Reappearance of ditto Occultation of B.A.C. 5395 (6) Reappearance of ditto			11 59·3
Thur	23	14 26 16 20	Near approach of 39 Ophiuchi (6) Occultation of θ Ophiuchi (3½)			12 59·4
Fri	24			**3rd Oc. R.** **2nd Oc. D.** **3rd Ec. D.** **1st Tr. I.** **1st Sh. I.**	7 57 8 18 8 37 44 10 16 11 15	Arcturus. 9 58·6
Sat	25	17 34	Conjunction of Moon and Saturn 3° 33′ N.	**1st Ec. R.**	10 50 3	9 54·7
Sun	26			**1st Sh. E.**	8 7	9 50·7
Mon	27	14 49	Near approach of 37 Capricorni			9 46·8
Tues	28					9 42·9
Wed	29	2 12·4	☾ Moon's Last Quarter			9 38·9
Thur	30					9 35·0
Fri	31			**3rd Oc. D.** **2nd Oc. D.**	8 44 11 2	9 31·1
JUNE. Sat	1			**1st Oc. D.**	9 31	9 27·1

MOON.

LIBRATION.
Selenographic long. and lat. of the point on the moon's surface, which has the earth's centre in the zenith.

TERMINATOR.
Selenographic longitudes of the points in latitude 60° N., 0° and 60° S., when the sun's centre rises or sets.

Greenwich, Midnight.	long.	lat.	60° N.	0°	60° S.
				SUNSET.	
1872.			°	°	°
May 1	+3·8	+6·6	—19·0	—17·5	—16·1
2	4·4	6·6	31·2	29·8	28·4
3	+4·9	+6·4	—43·3	—42·0	—40·6
				SUNRISE.	
9	+2·5	—0.5	+65·7	+64·6	+63·5
10	1·4	2·0	53·4	52·3	51·3
11	+0·1	3·3	41·1	40·1	39·1
—					
12	—1·3	4·4	28·9	27·9	27·0
13	2·6	5·4	16·7	15·8	14·8
14	3·9	6·1	+ 4·4	+ 3·5	+ 2·6
15	5·0	6·6	— 7·9	— 8·8	— 9·6
16	5·8	6·8	20·2	21·0	21·8
17	6·4	6·7	32·4	33·2	33·9
18	6·6	6·2	44·6	45·3	46·0
—					
19	6·4	5·4	56·8	57·5	58·1
20	5·8	4·2	69·1	69·7	70·3
21	4·9	2·8	—81·4	—81·9	—82·5
22	3·6	—1·2		SUNSET.	
23	2·2	+0·5	+73·2	+73·7	+74·1
24	—0·6	2·3	61·1	61·5	61·9
25	+1·0	3·8	49·0	49·3	49·7
—					
26	2·5	5·1	36·8	37·1	37·4
27	3·8	6·1	24·7	24·9	25·2
28	4·8	6·7	12·5	12·7	12·9
29	5·6	6·8	+0·3	+0·5	+ 0·7
30	6·1	6·6	—11·9	—11·7	—11·6
31	+6·2	+6·0	—24·1	—24·0	—23·9

SUN.

Greenwich, Noon.	Heliographical longitude of the centre of the sun's disc.		Heliographical latitude of the centre of the sun's disc.	Angle of position of the sun's axis.
1872.	°		°	°
May 1	56·61	$121+\delta\xi$	—3·90	335·85
2	69·85		3·79	336·04
3	83·08		3·69	336·23
4	96·32		3·58	336·44
—				
5	109·55	$+125\,\delta\xi$	—3·47	336·65
6	122·79		3·37	336·87
7	136·03		3·26	337·09
8	149·26		3·15	337·32
9	162·50		3·04	337·56
10	175·74		2·93	337·81
11	188·98		2·81	338·06
—				

12	202·22	+132 δ ξ	—2·70	338·32
13	215·47		2·59	338·58
14	228·71		2·47	338·86
15	241·95		2·36	339·14
16	255·19		2·24	339·42
17	268·44		2·13	339·71
18	281·68		2·01	340·01
—				
19	294·93	+139 δ ξ	—1·90	340·32
20	308·17		1·78	340·63
21	321·42		1·66	340·95
22	334·66		1·54	341·27
23	347·91		1·42	341·60
24	1·16		1·30	341·93
25	14·41		1·19	342·27
—				
26	27·66	+146 δ ξ	—1·07	342·62
27	40·90		0·95	342·97
28	54·15		0·83	343·33
29	67·40		0·71	343·69
30	80·65		0·58	344·06
31	93·90	+151 δ ξ	—0·46	344·43

THE PLANETS FOR MAY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	1 54 55	+10 42	11″·5	23 12·2
	15th	2 3 22	+ 8 58½	9″·2	22 25·6
Venus ...	1st	1 24 37	+ 7 14½	10″·5	22 42·0
	15th	2 29 39	+13 24	10″·2	22 51·8
Jupiter ...	1st	7 40 15	+21 59	33″·7	5 0·6
	15th	7 48 48	+21 38	32″·3	4 14·0
Saturn ...	1st	19 31 45	—21 28½	15″·6	16 50·1
	15th	19 30 54	—21 31	16″·0	15 54·2
Uranus ...	4th	7 59 4	+21 12½	4″·0	5 7·5
	16th	8 0 38	+21 8	4·0	4 21·9

Mercury is not in a good position for observation, rising about a quarter of an hour before the sun at the beginning of the month, the interval increasing to about three quarters of an hour at the end.

Venus rises about half an hour before the sun.

Jupiter is still well situated for observation ; towards the end of the month he sets before midnight.

Saturn towards the end of the month rises before midnight, and will be visible for the rest of the night, but too low to be well observed.

Uranus is still visible.

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The Astronomical Register.

No. 114. JUNE. 1872.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Seventh Meeting, May 10th, 1872.

Professor Arthur Cayley, F.R.S., *President,* in the Chair.

Secretaries—E. Dunkin, Esq., and R. A. Proctor, Esq.

The minutes of the last meeting were read and confirmed.

Thirty-three presents (chiefly serials) were announced and the thanks of the Society given to the respective donors.

The following papers were announced and partly read:

Observations of Planet 120: by Dr. Peters.

The places given extended from April 11 to 19. It appeared that Dr. Peters made an independent discovery of the planet on the 11th, in America, one day after it had been found by M. Borelly, at Marseilles.

Elements of Minor Planet 119: by M. Pechale.

The results arrived at from four observations are as follows:—

Epoch 1872. April 28·5, Mean Time, Berlin.

	°	′	″
M ...	164	2	4
π ...	36	34	33
Ascending Node	203	39	38
ι ...	6	30	31
ϕ ...	8	3	11
μ ...		862″·08	
Log. a			0·40964

Eclipse of Jupiter's Third Satellite, April 11, 1872: by Capt. Noble.

This was only 2m. 19·9s. after the *Nautical Almanack* time, showing, as Capt. Noble remarked, a great improvement either in the satellite or the tables.

Mr. Dunkin said the last eclipse of the fourth satellite differed only 4m. from the prediction.

Occultations of Stars by the Moon: by Capt. Noble.

The star B.A.C. 3579 disappeared at 9h. 48m. 37·2s. L.S.T. = 7h. 59m. 40·8s. L.M.T., and reappeared at 10h. 6m. 19·5s. L.S.T., = 9h. 17m. 10·4s. L.M.T.

The occultation of ι Leonis on the same night was partially observed.

On errors in Vlacq's Table of Ten figure logarithms of Numbers: by Mr. J. L. Glaisher.

The author read an interesting account of his inquiries on this subject, from which it appeared that most of the tables in use were reprints from Vlacq's, and had the same errors. He had collated all the tables of errata, and compiled a complete list, about 700 in number, out of the 100,000 logarithms in the table, but at least half of them were quite unimportant. He also asked for any information as to the life of Vlacq.

On the recent Solar Eclipse: by Col. Tennant.

The author in presenting a lengthy report of the observations made by his party, said that there was little of it which could be condensed into a conversational narrative, the principal results being the photographs which he exhibited. These were six in number, but one was imperfect from the clock stopping, and one had been damaged. The remaining four he hoped would be printed. Personally he had observed with a 6-inch telescope, stopped down to about 2½ inches, so as to secure a large field. Capt. Herschel's telescope, fitted with a spectroscope, was guided by the same movement as his, so that they might always observe the same thing. The result of the speaker's observations was that he was convinced every part of the corona was a solar phenomenon, the rifts and rays being all connected with the prominences. In the spectroscope no change from former results was noticed. The usual allowance of lines was seen. As the sun went out the number of bright lines increased, but the exact moment of extinction was lost, so that the complete reversal of the Fraunhofer lines was not witnessed. The lower part of the light, close to the moon's limb, appeared to consist of masses of vapours which effect the absorption, producing the dark lines. The bright lines in this stratum appeared in such enormous numbers that it was useless to attempt to identify them. They were seen on a somewhat light ground, it not being likely that the back ground could be entirely black. Some were noted, but they came out so rapidly close to the dark limb of the moon, that they could neither be counted or mapped in the two or three seconds available. The photographs were, he thought, as good as any that had ever been taken, at any rate, as to the three first, and he said this after having seen those taken by Mr. Davis (Lord Lindsay's assistant), at Bekul. One thing was absolutely certain, viz.: that the corona was connected with the prominences to a certain extent. (This was illustrated by a sketch.) The place immediately behind a prominence was comparatively dark. The rifts seem to radiate from the sides of the conical prominences. The photographs gave a very fair representation of the corona, as seen with the eye, but, of course, did not show the light extending so far as the eye alone could trace it. One portion was seen to extend quite a radius of the moon from the limb, but in the photographs it looked from 8′ to 12′ only. The original negatives, which were at Greenwich, shewed more detail than the glass positives exhibited. The corona decreased so rapidly in luminosity from the sun's edge, that the outer portion was very faint. In the reports of the 1870 eclipse it had been remarked that near the sun there was a ring of uniform brightness for a certain distance, beyond which the light degraded rapidly, but nothing of the kind could be seen on the last occasion. He was satisfied the diminution of the light of the corona was gradual in this eclipse, although there was a glare extending for 3′ or 4′ from the prominences. His party were extremely lucky to have done so much, for after several days of fine weather it rained heavily the night before the eclipse, which caused them to be enveloped in a thin mist next morning, through which the observations were made. Their elevation was 8,600 feet above the sea, and the air was bitterly cold and damp.

In answer to various questions Col. Tennant further stated that it was most difficult to notice the coming out of the bright lines, as they appeared by fits and starts, and there was always a dim coloured spectrum behind them.

Mr. Ranyard enquired whether all the lines came out at the same level, or whether the most marked ones were not higher than the others?

Col. Tennant said that he was not the spectroscope observer, and, therefore, could not answer this question, but as everything seen occurred in three or four seconds, he thought it unlikely this difference could be noted.

Mr. Ranyard: Perhaps I should rather have said different times than levels.

Col. Tennant: There certainly must have been a difference in times, but the succession was so rapid that lines could not be identified.

Mr. Ranyard: Was the spectroscope an integrating one?

Col. Tennant: No. It was an ordinary slit spectroscope. We made one of the kind referred to, but it broke down altogether, and, I think, we got on quite as well with the other.

Mr. Brett: If Col. Tennant, in speaking of a ring of uniform brightness in the corona nearest the moon's limb, refers to my observations in Sicily, I can only say that the appearance was most decided, but I only saw it just before totality.

Mr. Elger suggested that the mist spoken of by Col. Tennant might have diminished the light of this zone.

Col. Tennant: The mist was only a slight dampness, and looked as if we could almost push the telescope through it in a few feet.

Dr. De la Rue wished to remark on the great value of the photographs exhibited by Col. Tennant, which as far as his opportunities of comparison went excelled all he had ever seen. There was about them an amount of precision and definition very remarkable, which was quite conclusive evidence that the phenomena depicted were objective and belonged to the sun. As in 1860 the speaker's photographs proved that the prominences belonged to the sun, so Col. Tennant's now did the same for the corona. By looking at the connection of the rifts and prominences it would be seen as the moon moved, and covered and uncovered them, they kept together and occupied the same position in the last picture as in the first.

It would be very interesting to compare these photographs with those taken by Lord Lindsay's operator at a distance, and see if the principal points preserved the same positions in both. In 1860 the speaker was able to compare his pictures with those taken by Secchi at a distance, having an absolute difference of eight minutes of time, and proved the prominences were at the same angles. It was important to do this now, and ascertain if, apart from any change in the prominences during the time, they were seen in the same places.

Capt. Noble said that when the thanks of the meeting were given to Col. Tennant they would be the more hearty, as he had been the first of the observers who had come forward to remove the disgraceful state of ignorance in which the society had been kept by others, who had arrived here long ago. He then noticed that, whereas Col. Tennant spoke of a dark background to the prominences, observers, in 1870, at Gibraltar, saw just the reverse; one of the officers having told the speaker that wherever there were red mountains the corona extended further in those directions, and as this statement was made by a person having no preconceived theory, it was of considerable weight.

Col. Tennant said that two sketches made by Capt. Morant fully confirmed his statement, as in these the rifts seemed to diverge from the sides of the prominences, but he doubted if this were the case generally, as the corona was probably produced by jets from the prominences.

Capt. Noble enquired whether Capt. Tupman was present, and finding he was not, said his object had been to ask Capt. Tupman to read a telegram he had received immediately after the eclipse from the chief of the expedition, stating that the corona "was almost entirely atmospheric." It seemed, however, that the gentleman referred to had afterwards changed his opinion.

Rev. F. Howlett: Is there not a special difficulty in supposing the rifts to be connected with the prominences, when it is remembered that the latter are mere projections of very little thickness, but the rifts must extend entirely through the solar atmosphere?

Mr. Proctor thought the difficulty would disappear on considering that the corona could not be a shell surrounding the sun, but flatter and flameshaped. He had once suggested that its form might be produced by the revolution of a double hyperbola round the sun's axis, and the point started corroborated his view. We were driven to conceive of the corona as like cone-shaped flames, as anything like an atmosphere with rifts through it was quite inadmissible.

Dr. Huggins enquired whether any polariscope observations were made?

Col. Tennant said he meant to have done this, but the apparatus did not arrive in time. He indeed had a *Savart*, but found no time to use it. Dr. Broughton, who examined the vertical plane of the corona only, saw strong and unmistakable radial polarisation, and it was strong also where the corona was not visible. This must have been from some peculiar cause. In 1868 the polarisation was plain.

Dr. De la Rue had been going to ask the same question as Dr. Huggins, because there was another way of accounting for the rifts. The prominences gave less light than the photosphere, and, therefore, shut off light, leaving less to fall upon the corona.

Mr. Elger: In Sicily the drawings made, in 1870, by Professor Watson and Signor Carlentini, compared with those made at Gibraltar, showed that the rifts corresponded in being between the prominences, and that the corona was strongest over the prominences.

Mr. Ranyard made some further remarks, and a drawing on the black board to explain his views as to the black lines or sticks in the corona.

Col. Tennant said he doubted if we had data enough at present to discuss the subject further, but he would point out that in the photographs (he did not say always but generally), there were under the black radiations indications of faint prominences.

These were, of course, black divisions between brighter parts of the corona—not things of themselves but simply absence of light.

Mr. Ranyard: In Lord Lindsay's pictures there are four black sticks very well marked.

Col. Tennant said he had not before seen Lord Lindsay's pictures, but looking at them now he could see the prominences under these black lines.

After some further conversation as to the connection between the rifts and the sun's poles, Col. Tennant was asked how long the plates were exposed, and replied that the times varied very much. That originally it had been intended to act upon a system, but under the circumstances of the weather the operator had very wisely given this up. The exposures were 15, 10, 8, 5, and 6 seconds, and he thought the short exposure was as good as the longer.

Mr. Ranyard asked whether the outer corona could be seen in the original negatives, or whether it had disappeared in varnishing?

Col. Tennant: The negatives are at Greenwich and are not varnished, but I can see no more of the corona than in these positives.

Mr. Carrington enquired how the direction of the sun's axis had been ascertained?

Mr. Ranyard: By taking plates before the sun was covered, and using your formula, founded on data given by the direction of the spots.

On an Altazimuth Mounting for Telescopes, especially adapted for the use of Observers who have no permanent observatory: by Mr. J. Brett.

This telescope was exhibited and described by the inventor, but without an engraving will hardly be understood. When closed, nothing is visible but a rectangular polished mahogany box standing upright. This is the tube of a 9¼ inch silvered glass reflector, one side of which tube opens and discloses two legs made of brass tubes hinged in the middle, which, upon touching the ground, bend, and form with the tube a triangle, the telescope being the hypotheneuse. The lid of the tube opens back, and forms the nose-piece for the eye-pieces which are stowed away on the inside of another little door in the tube. The legs terminate in long steel screws, by which motion is given to the wooden tube. The speculum end resting on casters, quick motion in azimuth is obtained by moving the instrument bodily, and slow motion by one of the screws. Quick motion in altitude is given by drawing out the legs, and slow motion by one of the screws. The brass tubes contain springs to counterpoise the weight of the telescope. There is another door near the bottom of the tube to uncover the speculum, and the middle of the upper side is made of cane lattice work to avoid air currents in the tube. The mounting would do for any kind of telescope, but it is easy to get steady stands for refractors, and Mr. Brett thought for the Newtonian reflector this was both steady and portable.

Mr. Lassell enquired whether the telescope could be lowered to the horizon; and the President asked its weight?

Mr. Browning, who made the mounting, said the whole instrument weighed less than 40 lbs., and could be easily carried.

Mr. Brett showed that the telescope could be set to a very low altitude, and that, if the horizon were wanted, the speculum end could be set on a bench, and the required position obtained.

Mr. Dunkin enquired if the zenith could be observed?

Mr. Brett: Yes; but in that position the action of the screws is very slow.

Mr. Browning: I have worked with this telescope, and find it very fairly steady, and, as compared with most portable stands, it is *very* steady. It is also easy to follow a star with an almost equatorial motion by working both screws at once.

Dr. De la Rue said that the Society was much indebted to Mr. Brett for exhibiting so very portable and efficient an instrument, but he (Mr. B.) was under a misapprehension if he thought there was any difficulty in mounting large reflectors equatorially. To say nothing of Mr. Lassell's and the speaker's own instruments, the 4 foot reflector made by Mr. Grubb, of Dublin, was so beautifully mounted that a boy of fourteen could move it in any direction, and reverse the axis. With respect to air currents in the tube, he did not think the lattice work would get over that difficulty. He had found that sort of structure acted like a solid panel. There must be hardly any tube at all to prevent these currents.

Mr. Lassell: The whole of the lower side is open where the legs come out and retire, and I think there could hardly be any currents in this state of things.

Mr. Brett: The top is solid to keep the dew off.

Dr. De la Rue: I tried to make the tube of my telescope of lattice work, but was obliged to resort to a complete skeleton of 4 pipes only.

Mr. Lassell said such a skeleton mode of construction had the inconvenience of constituting a sort of Æolian harp in strong winds. He did not mean to say vibrations were audible to the ear, but they were to the eye.

In answer to a question, Mr. Brett stated that the speculum was bedded on felt, with a little play around for expansion.

Mr. Dunkin: The instrument appears very portable; is it intended for travelling?

Mr. Brett: That is one object, but readiness at home was equally aimed at. I can carry it out of doors and get it to work in five minutes.

Mr. Lassell: It appears to be a powerful instrument in a very small compass, and possessing great portability.

Note on the Discovery of Saturn's Second Satellite: by Mr. Proctor.

This paper referred to the discovery, by Sir W. Herschel, of the second satellite in order of distance from the planet, and was partly designed to elicit information on the subject. It has been usually stated that this discovery was the first fruit of the use of the 40-foot telescope, and made on the day that instrument was completed, but Dr. Robinson had denied this, and Sir J. Herschel had subsequently stated that he found, from a private memorandum of his father's, that the satellite had been discovered with a 20-foot telescope.

This has generally be enconsidered as final, but Mr. Proctor, having referred to Sir W. Herschel's papers, is by no means satisfied with the usually accepted result, and finds in the *Philosophical Transactions* statements which leave the whole question of the discovery open to further evidence, as there are passages from which it may be inferred that it was a result of the use of the 40-foot reflector. It is usually stated that the discovery was made in August, 1789, and the mention in the private journal that this was done with the 20-foot telescope would—*a priori*—be assumed to be correct, but a private and hurried entry is often wrong, while a public statement, which would necessarily be carefully read and revised, may be more correct than a mere formal entry. There is another mention of this discovery in the *Philosophical Transactions* for 1790, and again at the end of a list of nebulæ there is a note of the discovery of the sixth satellite, and a promise that an account of this discovery, *with the 40-foot telescope,* shall be read at the next meeting. The discovery was in August, and this was printed in November. Another piece of evidence is that Struve was presented with a copy of all Sir W. Herschel's papers, which must have been read over and annotated by their author, and Struve has stated that the 40-foot instrument led to the discovery.

Note on the Densities of Jupiter's Satellites: by Mr. Proctor.

These densities are uniformly quoted in our text books as very small, and generally in company with La Place's masses. Thus, in *Lardner's Hand Book,* they are stated to be lower in density than Jupiter himself, which makes them lighter than water.

Authors and compilers should not take these things for granted but examine them and give the authority for them. As a matter of fact the second satellite is about 2,000 miles in diameter, or a 40th of that of Jupiter. If it be of the same density as the planet, the mass would be 0.0000156, but it is 0,0000232, or nearly twice as much, so that the density is twice that of water. All the four moons are in the same category, and, therefore, even if the real diameter of Jupiter be not overrated, it indicates an approach in density to that of our own satellite.

Mr. Lassell remarked that the controversy between Dr. Robinson and Sir J. Herschel as to the telescope used in the discovery of Enceladus occurred in 1843, and was carried on by letters in the *Athenæum*. He recommended that this correspondence should be referred to. He thought Dr. Robinson was probably right, but did not admire his animus. With respect to the papers of Sir W. Herschel in the *Philosophical Transactions*, the author rarely mentions the instrument with which he made any observations. He says that the 40-foot telescope was completed on a certain day, on which day the sixth satellite was discovered, but he does not say it was with that telescope.

On Astronomical Units: by Col. De Crespigny.

On the Nutoscope, an Instrument for shewing Precession: by Professor Zenger.

On Tables of Jupiter's Satellites: by Mr. Maguire.

On the Value of the Stereoscope as applied to the examination of Eclipse Photographs: by Mr. Ranyard.

At the last meeting the combination of different photographs taken during a solar eclipse had been suggested as a means of proving that the corona is a solar appendage, and if such evidence could be relied on, its importance could not be exaggerated. The author, therefore, wished to examine how far such appearances could be trusted. The point is whether the rays are bodies of three dimensions, and upon this question shading has great influence. Artists constantly, by shading two dimensions, give an effect of solidity due to three measures, but this does not prove that there is a real parallax. During the discussion of a microscopical question, Mr. Beck photographed a glass tumbler covered with knobs, and the picture, if looked at one way, appeared in relief, and in another, pseudoscopic. So the eclipse streamers, if shaded, might look solid. We cannot be too careful in the use of lenses. Even a single convex lens, used to look at pictures of flowers, &c., will give a considerable effect of relief. In 1860, the photographs showed that the moon was passing over the prominences, and thus proved a real parallax; but the distant corona being further from the limb, and destitute of points for measurement, cannot be treated in this manner. The prominences can thus be shown to be behind the moon, and perhaps certain details of the corona might be measured in the same manner, but not the more distant and faint parts. As regards the value of the stereoscope in comparing photographs taken at a distance from one another, such as Lord Lindsay's and Col. Tennant's, it was remarkable to see how the light and shade were increased by superposing, and the stereoscopic effect increased in proportion. As to the moon appearing globular in such combined pictures, no one had ever described the moon as seen of such a shape during an eclipse, but only as a velvety disc of different colours. Its motion was only about 2′ during the totality, and was rotating on its axis in the contrary direction. He, therefore, thought that such a small motion could not produce pictures so different as to give the round form which had been referred to, and which certainly could be produced by combining pictures of the moon taken at the extremes of libration. Upon the whole it was not probable that any reliable evidence that the moon was a globe, or that the streamers of the corona were solid bodies, could be obtained from pictures taken during the few minutes of an eclipse when combined in the stereoscope.

Dr. De la Rue: I do not quite understand what Mr. Ranyard means by his body of three dimensions; or what he assumes the stereoscope is not capable of bringing out.

Mr. Ranyard: I mean the bringing out of the corona behind the moon as a body having some thickness.

Dr. De la Rue: I do not know who originated the theory involved in this latter point, but I am perfectly certain that the stereoscope enables us to see that the corona lays behind the moon.

In the course of some further conversation, Dr. De la Rue said that all kinds of corroboratory evidence were required and became valuable, but he thought Col. Tennant's photographs were quite decisive as to the nature of the corona being solar.

Mr. Ranyard said that Dr. De la Rue's pictures, in 1860, proved that the corona, near the limb, was solar, but it hardly seemed possible to fix upon any distant points and submit them to measurement in the same way as the prominences. Probably the pictures required a longer exposure to obtain greater extent and detail of the corona.

Col. Tennant said some of the coronal effect might be produced by terrestrial causes, but no one who saw the last eclipse could have any doubt that the corona near the prominences belonged to the sun, and that the moon passed over it just as it did over the prominences.

Dr. De la Rue: What is the diameter of this corona?

Col. Tennant: Quite a semi-diameter of the sun.

Mr. Brett enquired whether the rifts ever came as near the limb as five minutes, and was answered that they came quite close, or within a few seconds.

Mr. Proctor: The streamers cannot produce an extension of themselves. A great part of the coronal light is doubtless reflected.

Mr. J. Beck asked whether the polarization observations did not tend to prove that the coronal matter was of two kinds. In Spain his experiments led him in this direction. The difficulty of such observations lay in the polarized light prevailing in our atmosphere during the eclipse.

Mr. Proctor: The spectroscope shows more than this. Janssen saw bright lines in the corona, and also the black lines from the reflected solar light. We must receive a considerable quantity of light from that kind of matter.

Mr. Ranyard: I think Mr. Beck's observations answer himself. There is more polarization on the corona than on the dark moon.

The discussion, which had been extremely animated, here terminated, and the meeting adjourned.

The plans of the new apartments of the Society at Burlington House, and which it is expected may be ready in about a year, were exhibited in the library, and excited much interest.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE SUPPOSED PLANET VULCAN.

Sir,—Under the heading "Cui Bono?" an anonymous correspondent (and I would remark here, *en passant*, that persons when given to adverse criticism generally find it *convenient* to adopt a *nom de plume*, instead of affixing their names to their communications,) has endeavoured to show that the record of an observation made by Mr. Waite, of the suspected Planet Vulcan, is absolutely worthless in consequence of the indefinite character of the language employed. And your correspondent, waxing humorous, thought it could appropriately be placed side by side with the remarks of the renowned Mrs. Nickleby. In your last number also, he has continued (in reply to R. E. J.) to pursue the subject, and, "by way of illustration," takes up your valuable (and limited) space with a most absurd disquisition in regard to the meetings of the R. A. S.

Now, Sir, without referring to the letter of R. E. J., (who, like many of your readers, would, no doubt, like to see Astronomical subjects more simply explained,) I should like to say to "a subscriber" in regard to the observation by Mr. W., that I did not attach much importance to it, but simply placed it on record. believing as I do, that many facts which at one time are considered of no importance at all, may possibly acquire value at a future period, and be found of use for reference in a comparison with other observations. I know very well that Mr. W.'s statement was not altogether definite or satisfactory, and that it is scarcely possible the object he saw could have been a planet; probably it was a conspicuous sun-spot, and, if only this, I consider the observation worth recording, for it is not very often that a spot is visible to the unassisted eye, though (in consequence of the many large *maculæ* which have existed) during the last few years they have not been unfrequently observed.

"A subscriber" would have done much better if he had pointed out, briefly, the extent of the "incoherence and vagueness" of the statement in question, and not have ridiculed it in the manner he has done. It would have been much more appropriate I imagine.

Hollywood Lodge, Believe me, Sir,
Cotham Park, Your obedient servant,
Bristol: May 6, 1872. WILLIAM T. DENNING.

CONNEXION OF CONJUNCTIONS WITH METEOROLOGICAL CHANGES.

Sir,—The interesting discussion of the R.A.S., reported in the current number of the *Register*, shows the wonderful advances which are being made in that branch of science which connects astronomy and meteorology. It may not be uninteresting, therefore, to give the following very curious table, which would seem to show some remote connexion between planetary conjunctions and the disturbances in the atmosphere, as denoted by the barometric range:—

	Month.	Number of conjunctions or oppositions.	Range of Barometer.
1872.	January	4	1·80 inches.
	April	2	1·37 "
	March	1	1·01 "
	February	...	0·66 "

These remarkable results are rendered additionally suggestive by the phenomena which have accompanied the conjunctions. In January, for instance, there were conjunctions of Mercury on the 1st, and Saturn on the 3rd; two days after, the barometer plunged down to 28·84 inches. On the 15th and 19th, Jupiter and Uranus were in opposition, and four days after the barometer descended to the amazing depth of 28·35 inches! Thus each pair of conjunctions and oppositions was followed a day or so after by a remarkable barometric depression. Of course this may be merely coincidence, but it is very remarkable, nevertheless. The conjunction of Mercury on the 10th of March was accompanied by auroræ on the 8th, 9th, and 10th, and the next conjunction of the same planet, on April 24th, by heavy thunderstorms all over the country, from 23rd to 27th. On this latter occasion, namely, the 24th, Vesuvius burst into action. On the former occasion, March 10th, temperature fell 15°, and the barometer rose 0·83 inches, both within three days. I do not offer these facts as being of much importance, but they may prove interesting to many readers.

Yours respectfully,
London: May 10, 1872. OBSERVER.

CUI BONO?

Sir,—A "Subscriber's" reply to my letter of last March would, perhaps, be more properly answered by Mr. Waite than myself, but having once defended this gentleman's diction, I am induced to beg the insertion of these few lines, not with the view of continuing a controversy which can have little interest for your readers, but to show that the effete argument and puerile sentiments of your correspondent are far more below the standard of matter that one would look for in your publication, than the simple and honest statement of Mr. Waite which gave rise to this question. If a "Subscriber" took no particular exception to the "ordinary sized marble" form of expression, he implied it in his general condemnation of what he was pleased to call "the platitudes of the self-styled Observing Astronomical Society," and the idea conveyed to his mind that the marble might be the size of a bit of chalk, merely shows a lack of common apprehension on his part, inasmuch as I maintain that a spot on the sun described as being as large as an ordinary sized marble, does give an appreciable comparison of the two objects.

With reference to my mathematical acquirements, I know that two and two make what we are pleased to call four, and that ten twos make twenty; but I do not know what a long column of twos would be equivalent to without adding them together; and reasoning in this manner (not that my confidence in the law of gravitation is "shaky"), I venture to repeat that I have more confidence in the record of a fact happening as it were yesterday, than in the infallibility of any one calculating the position of the planets 4,000 years back.

The childish and exaggerated illustration a "Subscriber" gives of Mr. Waite's doubtful description of the time of year when the transit of the supposed planet occurred would not be worth notice, unless it were to draw attention to the care Mr. Waite took that he should not mislead. He says his house faced due West, and that the sun was setting immediately opposite, the implication to a mind of ordinary capacity being that the season must have been Spring or Autumn; but for the reason that he is unable to determine at which of these two periods the event happened, we are favoured with as lamentable an attempt at facetiousness as it is possible to imagine, probably to the amusement of a "Subscriber," but certainly not to the edification of any one who has taken the trouble to read his letter.

I am, Sir, yours obediently,

R. E. J.

London: May 6, 1872.

[We cannot insert any more letters upon this controversy.—Editor.]

THE UNFINISHED PROBLEM. IS THERE A LUNAR ATMOSPHERE?

Sir,—It was observed not long ago, by an American Professor, that "the hopes of Astronomy lie in the number of observers, and in the concentration of the action of many minds." Presuming, on looking at the scope and design of the *Register*, you may endorse the foregoing sentiment, I have taken the liberty, as a constant reader, to ask a place for a few remarks, on purpose to draw the attention of your *observing* readers, to an observed lunar phenomenon that I had the fortune to examine with my 11-inch silvered objective, in March last, and that considered at the time was intimately connected with and bore upon the solution of that question at the head of this communication.

The phenomenon I refer to was the unusual appearance of the shadow, which was resting at the time of observation, on that crescent-shaped plain which has been termed by Beer and Madler the most magnificent of all lunar landscapes when fully lighted up, viz., "Sinus Iridum," a well known region to every observer. However, as I am occupied this year in registering all my lunar observations, I will insert here from my note-book the exact impressions made in the observatory during the continuance of that phase of illumination which I am about to notice.

The most remarkable appearance in the field at this hour is the shadow which covers up the level plain of Sinus Iridum. It appears not to be black like the ordinary lunar shadow, it partakes just now of a *light grey.* I see dimly through it the surface below, indicating that close to the surface some etherial matter exists, which is capable to refract and absorb some of the incident tangent beams of the rising sun.

Bearing on the point I see the Rev. Mr. Webb, in his valuable treatise on celestial objects, mentions that the late great observer, Dawes, alone has traced a faint glimmering of light in the midnight shade of some of the lunar craters, which was the result of reflection from the cliffs above illumined by the full sun, and not from an atmosphere.

In the present case, it will be observed, the conditions are different, the light grey aspect must have had its origin from some other cause, for here the shadow was sweeping over a large open plain free of all cliff brilliancy, and from *Laplace* in the west to *Heraclides* in the east, the distance is over 200 miles.

From the German measurements of the high cliff ridge which surrounds the plain we get approximately the depth or volume of the shadow across it, which, at least, cannot be less than ten or twelve thousand feet. But this phase takes place only when, in the lunation, the upper limb of the sun is just beginning to show dimly the highest peaks on the most eastern portion of the great surrounding parallelism.

Hoping that in the May lunation some with larger aperture and longer focus will inspect the above lunar phase, I will insert here some of the lunar and terrestrial conditions at the time of observation in March last.

Toronto Time.

1st. Time of observation, March 19, 6 p.m.; or, G. M. T. 19d., 11h. 17m.

2nd. Moon from conjunction, 10d. 8h.; or, G. M. T. 10d. 15h. 25m.

3rd. Moon's distance from Apogee, 10 days motion.

In conclusion, I may add, that the above notice was suggested to the writer on perusing in your March number the different reports of the last eclipse expedition to the Royal Astronomical Society.

All the different impressions made, and the various renderings given, of the same phenomenon, by our most eminent observers, are truly perplexing. It may be traced now that by a very slight geographical change of the situation of the eye within the lunar umbra at this grand spectacle. The edge of the moon affects or changes greatly the entire solar aspect, which strongly suggests among other things the importance of making every effort to solve that problem, "Is there a lunar atmosphere?"

I remain, Sir, yours respectfully,
M. TURNBULL.

Spadina Avenue, Toronto, Ontario:
April 12, 1872.

TRANSIT OF VENUS.

We are very glad to be able to announce that the United States Senate has unanimously passed a bill, appropriating 50,000 dols. to meet the expenses of the observations upon the transit of Venus in 1874, on the part of the National Observatory in Washington. The bill has been introduced into the lower house, and will doubtless soon become a law.—*Nature.*

NOTICE OF A LECTURE BY PROFESSOR G. B. DONATI, ON "AURORÆ BOREALES, AND THEIR COSMICAL ORIGIN."[*]

Only the very few Italians who had travelled to regions much nearer the poles than their own country, had seen a grand aurora before October, 24, 1870.

Description of aurora of February 4, 1872 * * * * * About 8 p.m., there appeared in the south, in the constellation of Orion, luminous waves of no great size, which becoming continually brighter, mingled together; broke, disappeared, and re-appeared in forms always different; and finally arranged themselves like thin and very white darts, which formed a small but most beautiful crown, in fashion like a fan, with its concavity turned below. It seemed as if they formed an *aurora australis* on a smaller scale than the great general aurora.

Theories of Halley, Coates, and Marian. Electric theory insufficient. Electrometers do not indicate an extraordinary increase of electricity in the atmosphere during the development of auroras. Explanation of the auroral phases as a magnetic phenomena. That the aurora is an electro-magnetic phenomenon no one can now doubt—but are electricity and magnetism its cause, or merely its effect? The researches of Loomis prove that the number of auroras has a maximum and minimum about every ten years: and this is also confirmed by the examination which I have begun of a long series of records relative to auroras, in the observatory here * * * By that series it appears that in the period of about ten years, there are two or three consecutive years during which fine auroras are seen in places which are not very near to either of the poles of the earth; whilst in the intermediate years they are either not seen in those same places, or if seen are only very faint.[†] Since no known atmospheric phenomena can account for this decennial period, it is necessary to examine whether auroras, in place of being classed with purely meteorological, are not rather to be regarded as cosmical phenomena. This was Marian's supposition in 1733, and Olmsted's in 1856. Differing, however, from the special theory of the latter, Professor Donati proceeds to inquire whether auroras are really situated mainly in our atmosphere.

From the most accurate and recent observations, the principal phenomena of auroras happen at distances from the earth varying from 100 to 260 kilometres (from about 60 to 160 miles) and no physicist has assigned a greater height to the atmosphere than 60 kilometres (about 40 miles). It is impossible to deny that the auroral phenomena happens

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[*] Extracted from the "Nuova Antologia," March, 1872.

[†] The years of the present century in which fine auroras were seen in almost all Italy, though less striking than those recently observed, were 1805, 1826-27, 1837-38-39, 1848, 1859-60, 1870-72. It is seen at once that to obtain the decennial period above indicated there is wanting only the year 1815; nevertheless, in 1814 an aurora was seen at Parma.

(for the most part at least) far beyond the limits of the atmosphere, which is also the case with not a few of the falling stars which become visible to us far beyond those same limits. But it is unquestionable that neither of these phenomena can occur in a *void*. What then exists there? Poisson imagined an electric atmosphere above our own. Quetelet supposes another atmosphere which he call *etherial*; material indeed, but with a nature and composition quite different from ours. Donati thinks this very probable; only instead of *electric* or *etherial*, he would prefer to call it *cosmical*, or, better still, *solar*, if this last would not lead to confusion, since it cannot but be a portion of that which, before the origin of our planetary system, must have surrounded, and which still surrounds our sun, from whose mass and atmosphere, according to the most generally accepted cosmogonical ideas, all the planets, including the earth, must have come forth. He next refers to the ten years (about) corresponding maximum and minimum of the solar spots, of the deviations of the magnetic needle, and of the frequency and splendour of the auroras. All the maxima, however, are not equal. In the number of the solar spots, about every sixty years there is a maximum greater than the intermediate maxima; and such a period of maxima amongst maxima appears also to have been sufficiently established with regard to the magnetic needle and the auroras. What is the correspondency or *isochronism* in these cosmical phenomena?

Kepler[*] supposed, and many since have also tried to prove, that the ruling force in our solar system is no other than a result or transformation of magnetism. That the forces of nature are mutually and alternately transformed in a periodical and endless cycle, and that from such transformation arises all the life of the universe, is sufficiently proved by many facts; and therefore nothing is opposed to the admission that universal attraction and magnetism may be forces of which one is a consequence of the other, and which are nearly identical. But even without such conceptions, why may not magnetism act at the same immense distances as gravitation; and who shall deny that the sun and planets are as much magnetic bodies as the earth, and in most cases even more powerful? The only difference to be kept in mind is that whilst gravitation varies with the distances of the bodies, magnetism varies according to their relative position.

If then it be admitted, as seems natural, that there is a continuous interchange of magnetic currents amongst the various bodies of our system; if, that is, there exists a *cosmical magnetism*, this may afterwards combine with the proper and peculiar magnetism of every individual body, and determine in it phenomena that are special and inherent in its particular nature. Thus, for instance, it may determine on the sun the production of spots, and many other phenomena continually observed: on the earth it may be the cause of auroras, and the variations of the needle: and in the other planets of other different phenomena, of which this is not the place to speak. But these currents at certain periods will be stronger or weaker, according to the position occupied by the planets in regard to themselves and to the sun; consequently, the derived phenomena also will be subject to consimilar periods.[†]

(*To be continued.*)

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[*] *Astronomia Nova.*

[†] Donati in a note refers to his lecture on this subject in January, 1869, and says that since 1871, Professors Serpieri and Tacchini have continued their observations, which confirm the opinion he expressed in 1869. [See also a paper on *Further investigations on Planetary influence upon Solar activity*, by MM. De la Rue, Steward, and Loewy, in *Nature*, March 28, 1872].

REVIEWS.

Conversations on Natural Philosophy. By Mrs. Marcet.

We hail with pleasure the fourteenth edition of this useful and entertaining work, which has been revised and edited by the author's son, Francis Marcet, F.R.S. It has been made more complete by the introduction of two additional conversations on Spectrum Analysis and Solar Chemistry. The former principally derived from Mr. H. Roscoe's book upon Spectrum Analysis. It is astonishing in how clear and entertaining a light most of the leading facts of Natural Philosophy are explained in these dialogues. The whole is made plainer still by the numerous plates with which the volume is furnished.

Pamphlet of Extracts from the Thirteenth Volume of Astronomical Observations made at the Royal Observatory, Edinburgh. By C. Piazzi Smyth.

The title of this work gives a faint idea of its size and importance, it being a handsome 4to vol., of about an inch thick. It contains star catalogues from observation, a reprint of the immensely laborious account of observations of the Great Pyramid, which we noticed some time back. The form is much improved, especially as regards reference to the plates, to which there are some additions. A paper on Auroral and other faint Spectra; another on Scottish Meteorology, from 1856 to 1871; one on the Hyperborean Storm of Oct. 2nd and 3rd, 1860; and, lastly, a general description of the Royal Observatory, Edinburgh, and its occupation. There is an enormous amount of interesting matter in the volume. The paper upon faint spectra, in which some usually accepted dicta are questioned, is worthy of being well considered.

NEW NEBULÆ.

M. Borelly, of Marseilles, has communicated to the *Astronomische Nachrichten* the following catalogue of new nebulæ discovered by him at Marseilles. The positions are for 1872.

R. A.			Polar Distances.			
h.	m.	s.	°	′	″	
6	39	21	5	26	3	Nébuleuse assez faible, étendue, de forme elliptique, pas de point brillant.
6	48	44	4	4	20	Nébuleuse assez brillant, passablement étendue, ronde; noyau de 12.13 gr. au centre.
8	51	44	11	25	18	Nébuleuse assez brillant, 3′ d'étendue, de forme elliptique, pas de noyau.
11	37	50	72	43	31	Nébuleuse ronde, peu étendue, petit noyau au centre.
11	45	26	72	28	20	Nébuleuse assez faible, étendue, de forme elliptique, pas de point brillant.
11	45	3	72	25	46	Nébuleuse excessivement faible, à peu près ronde, presqu' inobservable.

NEW VARIABLE STAR.

M. Borelly notes a new variable star in R.A. 0h. 17m. 17s., and Decl. S. 10° 10′ 10″. On November 3, 1871, its magnitude was 6½; on November 8 it had sunk to the 8th magnitude, and on November 24 to the 10th magnitude. From November, 1871, to January, 1872, it underwent no change; and since then it has been invisible.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JUNE, 1872.

By W. R. Birt, F.R.A.S., F.M.S.

The lists for March and May, 1871, are available for observation in June, 1872. On p. 105 of the April number of the present volume, we have given supplement ☾ — ☉ from the 23rd, is the 31st of March, 1871, viz., 147° 34′ diminishing to 59° 4′. In Vol. IX., p. 128, the value of supplement ☾ — ☉ on May 21, 1871, was 152° 21′, and on May 31, 1871, is was 32° 8′. In the month of June, 1872, the value of supplement ☾ — ☉ on the 8th at midnight is 148° 37′ diminishing to 31° 35′ at midnight of the 18th. The two lists can therefore be combined as recommended for April and May.

It is necessary to remark that on the 26th of May, 1871, neither Piazzi Smyth nor Rumker were in sunlight. These craters may be looked for on the evening of June 13, and, if not then, in sunlight on the following evening, June 14. There is an erratum in note (*k*), for *Gandibert* read *Gaudibert.*

Sixth Zone of objects from North to South.

Atlas, Oersted, Franklin, Berzelius, Prom: Archideum (*a*), Tralles, Mare Crisium the eastern part, Picard with A and B of B and M, Snellius, Stevinus, Biela.

(*a*.) Prom. Archideum, a mountain range with a steep promontory to the North, between Geminus and Berzelius. It has a crater *a* of B and M opened on its northern summit.

This zone contains the interesting objects on the eastern part of the Mare Crisium, which have been very carefully studied by Webb. The six zones lately given will afford ample employment for the telescope, as the morning and evening terminators recede from the western limb, the objects can be well studied under the sunset illumination during the autumnal months.

On June 18, or earlier if in sunlight, the cleft from Hesiodus to Capuanus will form a fine study. Mr. Knobel has succeeded in tracing the cleft throughout its length without interruption. Observations of the cleft with large instruments are desirable.

Linne. The cone of Linné was observed as a small object on April 14. My record is as follows, "1872, April 14, 8.50 to 9.25 G.M.T., aperture 2·75 inches, power 100. I E γ^3, I E θ^1 and I E θ^2 very distinct; also the ridge I E γ^{24}, and the ridge forming the west boundary of the depression in which Linné is situated. At 8 hours this ridge was exactly on the terminator, all was dark eastward of it; at 8.50 a point of light a little eastward of it became visible. This point of light was *very small*, and apparently nearer to the west boundary of the depression than Linné is shown on my map of the Mare Serenitatis. If this point of light was the *earliest* illumination of Linné, the cone must be very small, scarcely larger than I E γ^3, which is now smaller than represented by Lohrmann and and M. Linne is certainly smaller than I E θ^2, I estimate I E γ^3 to be half the diameter of I E θ^2, and Linné two-thirds of I E θ^2. The terminator will pass over Linné on June 11, between 10 and 11 hours.

Possessors of the first sheet of my "Catalogue of Lunar objects" including area I A β, are requested to add the following, which were observed on May 15, between 8 and 10 hours, G.M.T.

I A β^{38}. An isolated mountain between Agrippa and I A β^9, shown by Schröter in T LXII, fig. 2, and by Lohrmann in both map and section I.

I A β^{39}. A peak on the S.E. border of Agrippa shown by Lohrmann only in his map and section I.

I A β^{40}. A cleft extending from I A β^{41} to I A β^{31}. It terminates at the northern part of the mountain, I A β^{31}, is a bright conspicuous object, and forks about the middle of its course. It is not shown by Lohrmann, but is well given by B. and M., on the New Edition of the large Map as *a mountain ridge*, forking as above described. Its character may be better determined under an earlier illumination than on the 15th of May. It is about double the width of the Hyginus cleft and brighter. It is found on De la Rue's photogram of Feb. 22, 1858.

I A β^{41}. A small mountain, N.E. of I A β^{6}. It is shown in fig. 2 of my notes and illustrations to the catalogue.

THE PLANETS FOR JUNE.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	1 54 55	+10 42	6″·6	22 29·1
	15th	1 59 4	+ 8 44½	5″·4	23 16·6
Venus ...	1st	3 52 48	+19 27	9″·8	23 7·9
	15th	5 5 11	+22 37	9″·8	23 22·4
Saturn ...	1st	19 28 13	—21 38	16″·2	14 44·7
	15th	19 24 51	—21 46	16″·6	13 46·3

Mercury is badly situated for observation, being too close to the sun, the greatest interval being three-quarters of an hour.

Venus is also unfavourably situated for the same reason.

Saturn may be seen almost throughout the night, but is too low to be well observed.

ASTRÆA, PALLAS, CERES.

The planet Astræa comes to opposition on the 4th of the month.

Date.	R.A.			Dec.	
	h.	m.	s.	°	′
2nd	16	50	58	—14	35
4th	16	49	3	—14	33½

Pallas comes to opposition on the 12th.

Date.	R.A.			Dec.	
	h.	m.	s.	°	′
2nd	17	42	18	+24	53
8th	17	37	17	+25	12
12th	17	33	52	+25	10

Ceres comes to opposition on the 26th.

Date.	R.A.			Dec.	
	h.	m.	s.	°	′
14th	18	35	0	—26	42½
22nd	18	27	29	—27	16
26th	18	23	35	—27	31½

ASTRONOMICAL OCCURRENCES FOR JUNE, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sat	1		Sidereal Time at Mean Noon, 4h. 41m. 6·13s.	1st Oc. D.	9 31	β Libræ. — 10 27·3
Sun	2			2nd Tr. E. 1st Tr. E. 1st Sh. E. 2nd Sh. E.	8 40 9 6 10 2 10 30	10 23·4
Mon	3	 19 21	Sun's Meridian Passage, 2m. 6·10s. before Mean Noon Conjunction of Moon and Mercury 0° 34′ S.			10 19·5
Tues	4	15 16	Conjunction of Moon and Venus, 0° 10′ N.			10 15.6
Wed	5	15 23·4 4 46 6 11	● New Moon Conjunction of Moon and Mars, 0° 35′ N. Conjunction of Uranus and Jupiter, 0° 1′ S. Saturn's Ring : Major Axis=40″·84 Minor Axis=16″·10			10 11·6
Thur	6			4th Oc. R.	8 12	10 7·7
Fri	7					10 3·8
Sat	8					9 59·8
Sun	9	5 18 6 24	Conjunction of Moon and Uranus, 3° 19′ S. Conjunction of Moon and Jupiter, 3° 22′ S.	2nd Tr. I. 1st Tr. I. 1st Sh. I. 2nd Sh. I.	8 32 8 46 9 36 10 11	9 55·9
Mon	10			1st Ec. R.	9 9 28	9 52·0
Tues	11			3rd Sh. E.	10 5	Moon. — 4 21·2
Wed	12					5 5·9
Thur	13	19 19·2	☽ Moon's First Quarter			5 49·3
Fri	14					6 32·2
Sat	15		Illuminated portion of disc of Venus 0·989 Illuminated portion of disc of Mars 0·998			7 15·8

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sun	16	17 49	Conjunction of Mars and Venus, 0° 41′ S.			8 1·1
Mon	17	 14 49 16 14	Sidereal time at Mean Noon, 5h. 44m. 11·05s. Near approach of μ Libræ (6) Conjunction of Mars and Mercury, 0° 21′ S.			8 49·5
Tues	18	5 38	Conjunction of Venus and Mercury, 0° 23′ N.	**1st** Sh. E. **2nd** Ec. R.	8 19 10 14 8	9 42·2
Wed	19		Sun's Meridian Passage, 0m. 39·22s. after Mean Noon			10 40·0
Thur	20	18 57·7	○ Full Moon			11 42·7
Fri	21	10 46 11 57	Occultation of σ Sagittarii (2½) Reappearance of ditto			β Libræ. — 9 8·7
Sat	22	0 29	Conjunction of Moon and Saturn 3° 23′ N.			9 4·7
Sun	23					9 0·8
Mon	24	9 46	Superior Conjunction of Mercury			8 56·9
Tues	25		Saturn's Ring: Major axis=41″·47 Minor axis=16″·59	**2nd** Oc. D. **1st** Tr. E.	8 43 9 37	8 52·9
Wed	26	15 29 15 52	Occultation of 30 Piscium (5) Reappearance of ditto			8 49·0
Thur	27	9 27·4	☾ Moon's Last Quarter			8 45·1
Fri	28					8 41·1
Sat	29	15 9 15 52	Occultation of B.A.C. 755 (6) Reappearance of ditto			8 37·2
Sun	30					8 33·3
JULY. Mon	 1					8 29·3

SUN.

Greenwich, Noon. 1872.	Heliographical longitude		Heliographical latitude	Angle of position of the sun's axis.
	of the centre of		the sun's disc.	
June 1	107°.15	+152 δ ξ	—0°.35	344°·81
2	120·40		0·23	345·19
3	133·65		—0·10	345·58
4	146·90		+0·02	345·97
5	160·15		0·14	346·37
6	173·40		0·26	346·77
7	186·66		0·38	347·17
8	199·91		0·50	347·58
9	213·16	+160 δ ξ	+0·62	348·00
10	226·41		0·74	348·41
11	239·66		0·86	348·83
12	252·91		0·98	349·25
13	266·17		1·10	349·68
14	279·42		1·22	350·11
15	292·67		1·37	350·54
16	305·92		+1·46	350·98
17	319·18		1·57	351·42
18	332·43		1·69	351·85
19	345·68	+170 δ ξ	1·81	352·30
20	358·94		1·92	352·74
21	12·19		2·04	353·19
22	25·44		2·16	353·64
23	38·69		+2·27	354·09
24	51·95		2·38	354·54
25	65·20		2·50	354·99
26	78·45		2·61	355·44
27	91·70		2·72	355·90
28	104·96		2·83	356·35
29	118·21	+180 δ ξ	2·94	356·81
30	131·46		+3·05	357·27

Assumed daily rate of rotation, 14°·2 + δ ξ.

MOON.

LIBRATION. SUN'S PLACE.
Selenographic long. and lat. of the point on the moon's surface which has the *Earth's* | *Sun's* centre in the zenith.

TERMINATOR.
Selenographic longitudes of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets.

Greenwich, Midnight.

	Earth's		*Sun's*		SUNSET.		
1872.	long.	lat.	long.	lat.	60° N.	0°	60° S.
June 1	+6°·1	+5°·1	—126°·2	—0°·01	—36°·2	—36°·2	—36°·2
2	5·7	4·0	138·4	+0·01	48·4	48·4	48·4
3	5·1	2·7	150·7	0.4	60·6.	60·7	60·7
4	+4·3	+1.3	—162·9	+0·06	—72·8	—72·9	—73·0

					Sunrise.		
8	−0·5	−4·1	+148·1	+0·15	+57 8	+58·1	+58·4
9	1·9	5 2	135·8	0·18	45·5	45·8	46·2
10	3·2	6·0	123·6	0·21	33.2	33·6	34·0
11	4·5	6·5	111·4	0·23	20·9	21·4	21·8
12	5·6	6·8	99·1	0·25	+8·7	+9·1	+9·6
13	6·4	6·8	86·9	0·28	−3·6	−3·1	−2·6
14	7 0	6·4	74·7	0·31	15·9	15·3	14·8
15	7·3	5·7	62·5	0·34	28·1	27·5	26·9
16	7·2	4·7	50·3	0 36	40·4	39·7	39·1
17	6·6	3·4	38·1	0·39	52·6	51·9	51·2
18	5·7	1·9	25·9	0·42	64·9	64·1	63·4
19	4·3	−0·2	13·7	0·45	−77·1	−76·3	−75·5
20	2·6	+1·6	+1·5	0·48	Sunset.		
21	−0·7	3·2	−10·7	0·51	+80·1	+79·3	+78·5
22	+1·2	4·7	22·9	0 54	68·0	67·1	66·2
23	3·0	5·8	35·1	0·57	55·9	54·9	53·9
24	4·7	6·5	47·3	0·60	43·7	42·7	41·7
25	6·0	6·8	59·5	0·62	31·6	30·5	29·4
26	6·9	6·6	71 7	0 65	19·4	18·3	17·2
27	7·3	6·1	83·9	0·67	+7·2	+6·1	+4·9
28	7·4	5·3	96·1	0·69	−5·0	−6·1	−7 3
29	7·0	4·2	108·4	0·72	17·2	18·4	19·6
30	+6·4	+2·9	−120·6	+0·74	−29·3	−30 6	−31·9

The sun's disc passes the true horizon of Linné on June 12, from 6h.4 to 7h 6 G.M.T.

Books received.—"Pamphlet of Extracts from the Thirteenth Volume of the Astronomical Observations at the Royal Observatory, Edinburgh. By C. Piazzi Smyth. Neill and Co., Edinburgh, 1872." Mrs. Marcet's "Conversations on Natural Philosophy." Longmans, Green & Co., 1872. R. A. Proctor's "Essays on Astronomy." Longmans & Co.

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SMYTH'S CELESTIAL CYCLE.—Our Sydney Correspondent, whose exact address we have mislaid, is informed that we can procure a good copy of the above work for him on same subject.

NOTICE.—It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 115. JULY. 1872.

ROYAL OBSERVATORY, GREENWICH.

THE VISITATION.

The annual inspection of the Observatory by the official visitors took place on Saturday, June 1, when, in addition to the Members of the Board, a number of scientific men availed themselves of the invitation of the Chairman of the meeting, to make a visit to this most interesting Establishment and inspect the instruments with which so much valuable work is accomplished. The Observatory was opened at two instead of three o'clock, as on former occasions, so that ample time was secured for careful examination of the buildings and their contents. The Report of the Astronomer Royal goes minutely into detail of the work performed, and the state of the reductions and printing, and describes the present condition of the buildings and instruments. No alterations of any importance have been made in these respects, the principal addition having been that of a new normal sidereal clock, by Dent, to distribute sidereal time throughout the Observatory and make the seconds punctures on the chronograph, which, being erected in the magnetic basement, and thus kept at a uniform temperature, has rendered the clock rates almost constant; the only fluctuations observed now being due to changes in barometric pressure, which can readily be estimated and allowed for. The objects of most interest to the visitors, both official and unofficial, appeared to be the instruments and observatories prepared for the Transit of Venus in 1874, which were to be seen dotted about the grounds. The observatories are of wood, and generally hexagonal in form. Those for the Altazimuths have revolving roofs, but for the Equatoreals portions of the roof can be removed as required. The stations, it may be remembered, are five in number, and for each a transit, an Altazimuth and a 6-inch Equatoreal have to be provided. Three first-class clocks, besides extra telescopes and clocks, will be wanted for each station. Most of these instruments are ready and were exhibited. The beautiful Altazimuths of Messrs. Simms, and the Transits by Messrs. Cooke excited universal admiration. The Equatoreals, which, as a rule, are not new, are not quite complete, but among them is the celebrated one formerly belonging to Admiral Smyth, and afterwards to Dr. Lee, and now adapted for the station at Alexandria. Many of those present recognised an old friend in this instrument to which they had been indebted for many delightful views of the heavenly bodies when at Hartwell. We were glad to find from the Report that the merits of the assistants have been acknowledged by some increase in their salaries granted by the Admiralty. The Observatory may well be proud of the devotion of these gentleman to their duties and the manner in which the work is performed, and this recognition is only what they have long deserved. The Astronomer Royal also hints that he is preparing a sketch of the history of the Observatory during his term of office which will partake of a biographical form. We need scarcely say that, looking to the vast improvements in instruments and other changes which have been introduced since 1836, this account of his labours will possess the greatest interest to all astronomers.

Perhaps the most important part of the Report is the notice in which the Astronomer Royal draws attention to the probable necessity of taking up a different class of observations in addition to those for which the Observatory is famed. He suggests that those phenomena which can be observed at convenient times, with moderate instruments, and without continuous expense, such as measures of double stars, may well be left to private observers; but that where large telescopes, constant routine and consequent expense are required, a public observatory should be employed. The scrutiny of nebulæ and planets and solar spectroscopy may *possibly* fall within this category; but he has *no doubt* that a continued series of observations of the solar spots should be carried on, and he recommends that, with this object in view, another assistant should be added to the strength of the establishment. With these and other like investigations supplementing the magnetic and meteorological observations already constantly made, Greenwich would become *pro tanto* a *physical observatory*, and as such might, in future, produce results comparable in value with its meridional work.

These remarks, no doubt, occupied the earnest attention of the Board during their protracted sitting, and will, doubtless, bear good fruit.

The visitors and their friends dined together as usual in the evening.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

Eighth Meeting, June 14th, 1872.

Professor Arthur Cayley, F.R.S., *President,* in the Chair.

Secretaries—E. Dunkin, Esq., and R. A. Proctor, Esq.

The minutes of the last meeting were read and confirmed.

Thirty-nine presents were announced and the thanks of the Society voted to the respective donors.

Rev. W. Falconer,
E. Sheppard, Esq.,
W. Mathieu Williams, Esq.,
Rev. Thos. Tordiffe,
H. W. Jackson, Esq., and
Rev. F. W. H. Courtier,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:

Discovery of Planet 121: by Professor Watson.

This small planet was discovered on May 12, in the United States.

On New Tables of Uranus: by Professor Simon Newcombe.

This was an extract of a letter to the Astronomer Royal asking for the last Greenwich observations of the planet, and stating that the author intended to conclude his labours with the use of the places obtained at the opposition of 1871-2, and hoped, after twelve years' work, very shortly to bring the matter to a close. So far as he had at present compared the results with observation, his tables gave the places within a fraction of a second of time and a second of arc, and the theory gave no indication of the existence of any trans-Neptunian planet.

Mr. Dunkin said that the Tables of Neptune now in use gave the places with the same degree of accuracy. He also added that M. Leverrier had published an important paper in the *Comptes Rendus* on the theory of the planets Jupiter, Saturn, Uranus, and Neptune, which, at the request of the Astronomer Royal, he (Mr. D.) was translating for the *Monthly Notices.*

Occultations of Stars by the Moon, and Phenomena of Jupiter's Satellites: by the Rev. Mr. Main.

These observations were from fifty to sixty in number, and Mr. Dunkin observed that they showed the Tables of Damoiseau represented the phenomena of Jupiter's Satellites better than was usually admitted. As to eclipses of the 1st satellite the errors were almost *nil;* with the 2nd satellite, a few seconds; as to the 3rd, about a minute; and with the 4th, about three minutes. The other phenomena were not so exact; one transit egress was twenty-three minutes wrong, but the observation was a very bad one, and made under exceptional circumstances of weather, and the view being obstructed.

On the Aurora of February 4, 1872: by the Rev. Mr. Slatter.

These observations, compared with others gave, the author considered, a result showing the height of the phenomenon was 118 miles.

On the Radiant Points of Meteors: by Mr. Greg.

This was a very valuable table of the radiant points and epochs of the groups known, collated from the various observations, which agreed better than might be expected. From the researches of Schiaparelli great interest attached to the subject.

Mr. Glaisher bore testimony to the great value of this Table, with which he was well acquainted, and found it of much service where any discrepancies existed as to the radiating points of groups, by limiting the area of search.

Addition to Paper on the Errors of Vlacq's Tables of Logarithms: by Mr. J. W. L. Glaisher.

The author explained the object of this paper as being to give further corrections which had been omitted in Vega's errata.

On Photographic Irradiation in Over-exposed Plates: by Lord Lindsay.

The most cursory observer of eclipse photographs must have noticed the occurrence of a halo of light extending over the dark limb of the moon, and having a different extent where there are prominences to where there are none. This is similar to the nebulous haze or border seen in over-exposed pictures of other objects. The effect had been referred to an extension of the chemical action continuing after the light had been cut off, but, whatever the cause, the author proposed to call it *Photographic Irradiation,* and had performed an extensive series of experiments to ascertain, if possible, the circumstances under which it was produced, and the best means of preventing it. The halo in these pictures consisted of two parts, an inner luminous border and an outer less defined fringe. The boundary between the two is difficult to fix, as they fade gradually into one another. The edge of the moon and outer limb is, of course, better defined. Lord Lindsay then detailed the apparatus and method used in order to test the production of and get rid of these appearances. A plate of blackened zinc, with a triangle cut out of it, and a wire crossing the space, was placed in front of a gas flame, and a negative taken in a portrait camera on a plain white glass with one minute's exposure. This formed an excellent standard picture. Other pictures, with the same focus, were allowed from ten to twenty minutes, and these all had extensive fringes or halos surrounding the triangle. Other plates were then tried, including white glass with one side ground, and with both sides ground. These gave results very little better. A backing of white or black paper was tried, but unless kept adherent by moisture made little difference. A backing of black asphalte varnish, giving a very dead black, was a great improvement; and non-transparent plates, such as slate and ebonite, hardly showed any halo in ten minute's exposure. The black varnish over half a plate and the other plain showed the great advantage of this mode of backing. One of the best materials was a yellow glass used for photographic dark-room windows, and called yellow *pot metal*. This, when ground on both sides and varnished, produced pictures in which it could hardly be seen whether it had been exposed for one or ten minutes. An incandescent platinum wire, heated by ten cells of Grove's Battery, was also tried as the source of light. In ten seconds the halo was hardly visible; in ten minutes very markedly produced. In order to test whether the effect was produced by chemical or optical causes, a small ivory rule was held against the collodion plate by capillary attraction, when the picture was found to be cut clean off by the limb of the rule. Apertures in black paper were printed by contact in daylight in the usual manner, but the action was found not at all to extend under the edges of the holes. The author was about to repeat this experiment with a silver plate and various apertures, and also to use dry collodion plates. He thought such plates with a dark back would do very well. These experiments seemed to show that by proper precautions the greater part of these defects in photographic pictures might be eliminated, but there would remain a very fine band of light at the limb of the moon which rendered the image different in size to that seen on the ground glass, and the extension of this halo was greatest where the light was the strongest.

Dr. De la Rue wished to bear testimony to the great value of these experiments. He gathered from them that the irradiation was caused by the reflection of light from the back of the plate. This was somewhat contrary to his expectation, but also showed that it could be pretty well eliminated. Another point was that attributing the effect to a sort of continuance of the chemical action where the light impinges he had mentioned at Greenwich, that he thought it probable the mode of producing the achromatic correction of Dallmeyer's lenses might have something to do with the effect, but he now found this could not be concerned in producing the action in question.

Mr. Ranyard said, that having seen some of the experiments, he had no doubt there was no evidence of chemical action continuing over the plate, as the rule cut off the irradiation sharply. The border was also not due to chromatic error, but seemed to be connected with the back reflection. This defect was of great importance with regard to photographing the Transit of Venus, as it would enlarge the picture of the Sun and diminish that of Venus, and there seemed no means of saying to what extent this might act. It appeared, however, that irradiation might be greatly lessened by using a reflecting telescope.

Lord Lindsay said that he had omitted to mention that with a 4-inch reflector, lent by Mr. Browning, he had obtained a much better image on the collodion of the ivory rule.

Dr. De la Rue suggested that after all the elimination possible of the irradiation, there might still be something due to continuance of chemical action.

Lord Lindsay said that after sensitizing, the collodion appeared somewhat in relief, and might act as a cylindrical lens.

Col. Tennant suggested that the apparent convexity of the image was caused in the development.

Dr. De la Rue said that with regard to the Transit of Venus observations, as the measurements would be made from centre to centre of the Sun and Planet, no error could be introduced by the irradiation.

Observations of the Planet Venus: by Mr. Langdon.

This gentleman is station master at a small country station, and having made himself a 6-inch silvered-glass reflector, had observed Venus at intervals from May 1, 1871. At first his observations were unsatisfactory and hazy, but by employing a diaphragm of blackened card with a very small hole or a slip of lightly tinted glass, he had seen a cloudy marking nearly across the Planet with pointed ends. Venus was then rather more than a half-moon in shape. He saw the same marking half an hour afterwards, and on the next evening. On May 6, he saw a club-shaped mark and some others. These he watched with great interest, having heard the existence of such marks doubted, and called several of the railway men to look, who corroborated his observations. On May 13 and July 28, he saw some dusky marks at the terminator, and the southern horn much rounded, while the northern was quite sharp. In October both horns were sharp and some cloudy markings visible. On October 25, he had a fine daylight view, when the sunlight taking off the glare, the jagged nature of the terminator was seen, and the northern horn looked as if bent inwards to the centre of the planet. This had not been seen before or since. On November 9, he watched Venus at every half hour during the day; the terminator was jagged and looked like a piece of lace. On February 5, 1872, a few days before inferior conjunction, he saw the whole body of the planet like the moon when visible by the ashy earth light. He had strongly suspected this at other times, but on this occasion he had no doubt of the accuracy of his observations.

On Improvements in Tripod Stands: by Mr. Lecky.

Mr. Lecky exhibited a stand founded on the usual double-legged tripod used for photographic cameras, and which he stated was originally invented by Mr. John Jackson Lister, the great improver of the microscope for a camera lucida. Mr. Lecky had added certain braces and other modifications which rendered the stand very stiff and capable of being used for drawing, or to support a telescope, &c., with great advantage.

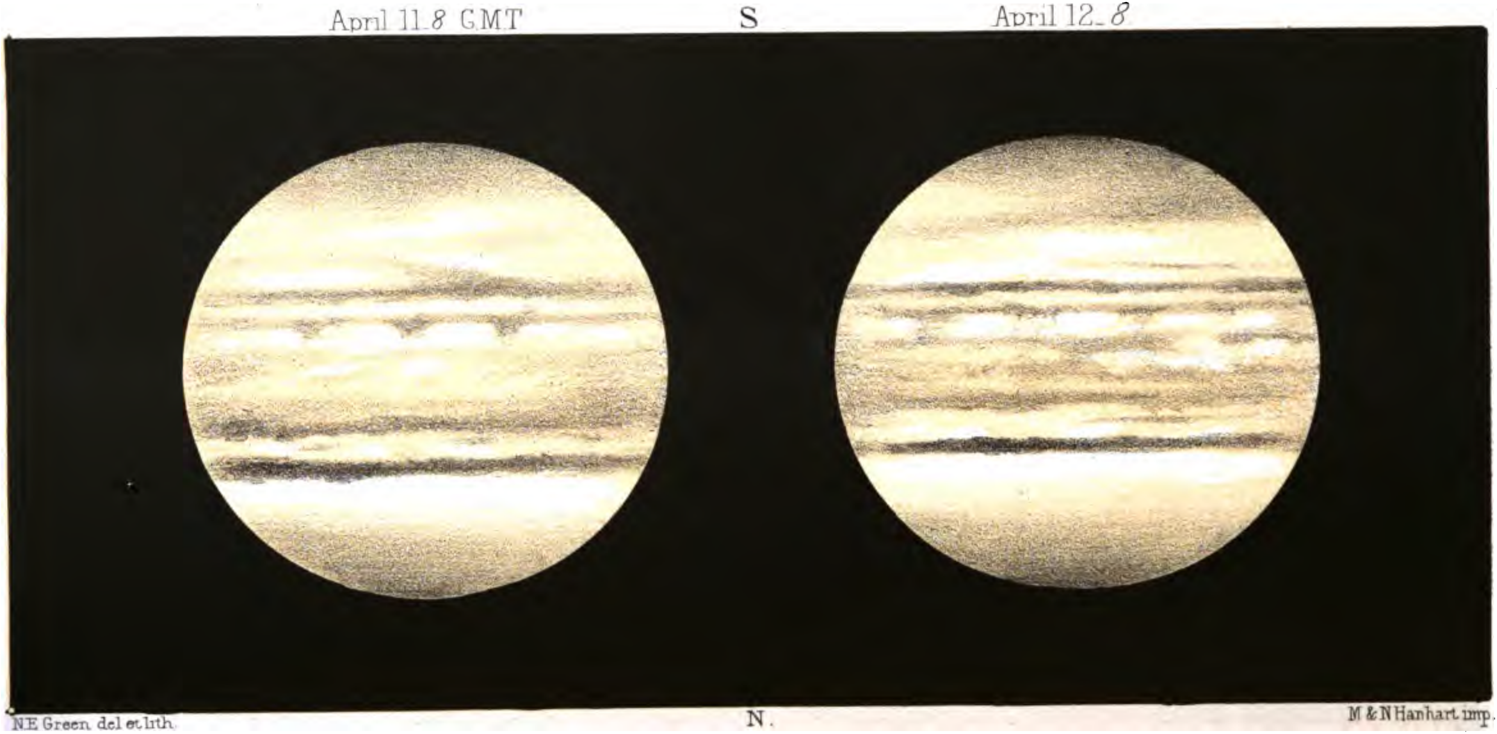
On the Orbit of Castor: by Mr. Wilson.

In a paper printed in the last *Monthly Notices*, the author had shown reason for believing that the orbit of this pair of stars might be hyperbolic. This result had been obtained by a graphical method; but he had since worked out the orbit analytically by Sir. J. Herschel's process, which he described and illustrated. The divergence of the result of this from the graphical method was great; but the latter is not to be trusted as compared with the former, on account of a very slight error vitiating the whole operation. The author referred to a chart of all the observations, and a curve drawn through them, which appeared very irregular and unsatisfactory. The interpolated curve had been corrected by the method of differences employed by Sir J. Herschel. Upon the whole the result of the analysis confirmed his former views. It is very desirable to examine the spectra of the two stars A and B composing Castor, but he has not yet had time to do this. Should the form of orbit suggested by him be confirmed, we have seen a near approach of the two stars which will never happen again.

Dr. Huggins, at the request of the President, gave an oral statement of the substance of a paper read at the Royal Society on the previous evening, detailing his further *Spectroscopic observations* with the large telescope now in his possession. The matter of the paper was divisible into two parts. One related to a more careful comparison of the brightest line in the spectrum of the gaseous nebulæ with the nitrogen line, and the second division was an extension of the investigation of the motion of Sirius to other stars. With respect to the first subject, the observer ought to be very sure that the method of sending the light for comparison into the instrument was as perfect as possible, which the ordinary prism over part of the slit was not. He had tried a modification of this method in the shape of a small silver plate, which, with great care, was much more trustworthy. In the researches on Sirius, he had depended not only on this reflector, but had also placed his light for comparison in front of the object glass; but with a telescope 15-feet long, this was both inconvenient and troublesome. He had now, therefore, placed the vacuum tube or electrodes in the telescope itself exactly in the axis of the instrument, the tube being covered all but about the one-tenth of an inch. It would be remembered that immediately after seeing the three bright lines of the gaseous nebulæ, he had found that the brightest coincided with one of the nitrogen lines. This was a double line, and he had tried to discover whether the nebulæ line was so also, but the 8-inch telescope did not give light enough, nor was the spectroscope dispersion strong enough. He was now certain that the line of the nebula was single only, and coincided exactly with the centre of one of the nitrogen lines, both of which were nebulous in character. There were two explanations of this. It might be that the line under certain conditions of temperature and pressure became single and defined at edges. A motion of 30 or 40 miles per second would cause the line to shift from the middle of the double line to the less refrangible one. He had tried whether the nitrogen line became single when made excessively rare, but it did not. He felt pretty certain that the nitrogen line continued double, and did not shift under the conditions mentioned. It therefore stands that the nebula line may not be nitrogen at all, or may shift its place and partly fade out under certain conditions of motion, temperature, or pressure not yet ascertained. His experiments had been made on the nebula in Orion, but he meant to try others to decide the point.

The second part of his paper related to the observations on the proper motion of the stars being an extension of his method applied to Sirius to stars somewhat smaller. His former paper placed the result as to Sirius as giving the motion of that star from the earth at twenty-five miles per second, but a repetition of the

JUPITER 1872.



From drawings by N.E Green, 9 inch With Browning reflector.

observations had reduced this to a velocity of from eighteen to twenty-two miles per second. Other stars had been examined, the results being embodied in the following Table.

The numerical results are provisional only, as the amount of shift could only be estimated.

STARS FROM SUN.

	Compared with.	Apparent motion.	Earth's Motion.	Motion from sun.
Sirius ...	H	26 to 36	—10 to 14	= 18 to 22
Betelgeuse ...	Na	37	—15	= 22
Rigel ...	H	30	—15	= 15
Castor ...	H	40 to 45	—17	= 23 to 28
Regulus ...	H	30 to 35	—18	= 12 to 17
β Leonis ...	H			
δ Leonis ...	H			
β γ δ ε ϑ Urs. Maj...	H	30	—9 to 13	17 to 21
η Urs. Maj. ...	H			
α Virginis ...	H			
α Cor. Bor. ...	H			
Procyon ...	H			
Capella ...	H			
Aldebaran ...	Mg			

STARS TOWARDS SUN.

	Compared with.	Apparent motion.	Earth's motion.	Motion towards sun.
Arcturus ...	Mg	50	+5	55
α Lyræ ...	H	40 to 50	+3·9	44 to 54
α Cygni ...	H	30	+9	39
Pollux .	Mg	32	+17	49
α Urs. Maj. ...	Mg	35 to 50	+11 8	46 to 61
γ Leonis				
ε Bootis				
γ Cygni				
α Pegasi				
γ Pegasi				
α Androm.				

Speaking generally, those stars opposite Hercules were receding from, and those near that constellation were approaching to, the sun, but there were exceptions. It was almost certain that the motion was compounded of three parts: 1st, an apparent motion, due to Sun's motion towards Hercules; 2nd, a probable motion of great groups of stars; and 3rd, a probable motion of separate stars. Mr. Proctor had obtained from his graphical exhibition of the proper motions of stars strong evidence in favour of their motion in groups. There was a remarkable instance in the Great Bear, where five of the seven principal stars had similar proper motions, and α and η had proper motions in opposite directions. The spectroscope showed all five receding, and α to be approaching. The spectra of the five stars were similar, while that of α was different. Castor and Pollux had different proper motions, and their spectra showed that one was approaching and the other receding. In Leo α and β had proper motions agreeing, and their spectra showed they were moving from the earth, but with γ Leonis both proper motion and direction were the reverse.

Mr. Proctor said that he remembered when his Paper on Star Drift was read to the Royal Society, and he had referred to spectrum analysis as likely to support his views, the Chairman (the late Dr. Miller) expressed doubts whether this could ever be used except in the case of a few very bright stars, and he (Mr. P.) had said that if it were done Dr. Huggins was the person to do it. He (Mr. P.) now felt prouder of having prophesied this than of the paper which had called attention to the effect of the proper motions.

On the Tides in Mars: by Mr. De Crespigny.

Mr. Proctor said that the author in advocating the existence of tides in Mars without a moon had omitted several considerations, and he did not think we had any evidence in support of the hypothesis of such tides.

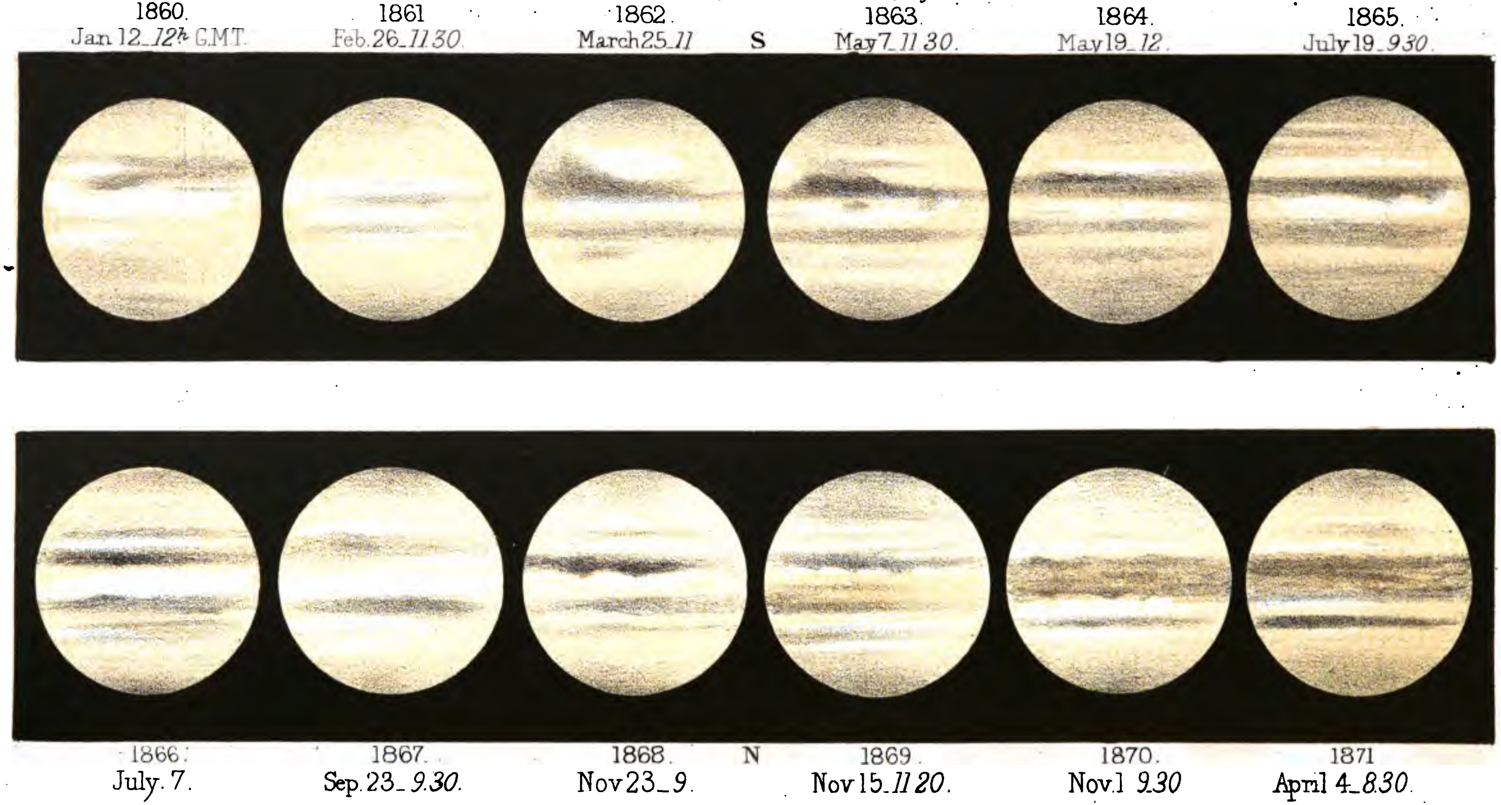
Observations of the Spectrum of the Zodiacal Light at Palermo: by Professor Piazzi Smyth.

Angstrom found in this spectrum the same bright line seen in the terrestrial aurora, and Lias, in Brazil, saw also a strong continuous spectrum. Webb, in England, arrived at the same result; and Respighi, during his return from the eclipse, saw also the auroral line in the Zodiacal light, but a few days later saw it equally distinct all over the heavens. It might, however, have been connected with an aurora. Professor Smyth describes the instrument he used, and with it, at Palermo, saw the line in the aurora. With the same spectroscope and slit he looked at the Zodiacal light, but could see nothing whatever. With a wider slit he saw a continuous spectrum. This seems to show that the observers have been deceived, and instead of the Zodiacal light they have observed a faint aurora. The author compared the Zodiacal light and faint twilight, which agreed exactly. He also observed the phosphorescence of the sea, which gave a continuous spectrum, but the maximum was not the same as in that of the Zodiacal light and twilight. The general starlight gave the same result.

Mr. Proctor thought the observations rather doubtful, from Professor Smyth having used so many as nine prisms. With three or five he would have had a better chance upon such objects.

BELTS OF JUPITER.

From Drawings by N.E Green, aperture of object glass. 4 in.



On the Desirability of Watching for the November Meteors in the Present Year: by Mr. Proctor.

It having been recorded that no meteors were seen in several hours last year, Mr. Glaisher had stated that it would be unnecessary to watch again, but the author found that in Italy and at Alexandria a good many were noticed producing some approach to a display. Schiaparelli had also noticed that in 1818 there was a fine shower. This was when the cluster would be about half way round its orbit. Mr. Proctor, therefore, counselled keeping watch for several nights at the usual period for seeing the Leonides.

On the rich Nebular Regions in Virgo and Coma Berenicis: by Mr. Proctor.

This paper referred to a chart of all the stars in this part of the heavens, from Argelander and all the nebulæ from Sir J. Herschel's catalogue. The author noticed that where the clusters seemed breaking up, nebulæ were also abundant; but where this appearance was absent, there were also no nebulæ.

Mr. Browning exhibited a small model of a lunar crater, made by General Worcester, designed to show the capability of a new material, composed of prepared chalk, milk of sulphur, and gum water, which could be worked upon in a plastic state for some time, and then set very much harder than plaster of Paris, and could even be altered by moistening with gum water again.

On certain Phenomena seen surrounding the Limb of the Sun in Telescopes: by Mr. Brett.

In solar eclipses a halo is seen round the moon, but the observations have hitherto been limited to total eclipses. The author has observed certain appearances which seem to indicate that we may perhaps see the corona every day. Of course what he noticed was not on a black ground, but a sort of halo of a steel-grey with a tint of green in it. The aperture of the telescope is not of much consequence, but the dark glass employed must be of the lightest tint that can be used. Sometimes even the appearance of such rifts as were noticed in the eclipse of 1870 had been seen, and he had shown the phenomena to several persons. He had tried all means to get rid of them in vain, and finding his observations corroborated, thought they should not be suppressed.

Mr. Browning had tried the experiment, and in many instances he had succeeded. In using a silver film to deaden the light, a huge halo was produced, and at first he thought this was the sole cause of the colour, but he found it equally present with different kinds of neutral tint glasses. With a 12½-inch reflector or a 2-in. achromatic, he always got a luminous edge round the sun's disc.

This morning he had noticed an appearance of which he made a sketch on the blackboard. He did not say it was a solar corona, but it did not arise from the eye-piece or the coloured screens. Dr. Huggins had suggested it might be due to the eye of the observer.

Dr. Huggins mentioned that a friend of his had looked for these appearances in vain.

Capt. Noble said that some years ago* he observed the dark limb of the moon projected on the sky during a partial eclipse, and, upon stating it to the society, was asked by the Chairman (Professor Pritchard) whether he was using a coloured glass, and upon his replying yes, was told that "accounted for anything," but perhaps after all his observation was not so worthless as had been supposed.

Mr. Chambers said he had seen the phenomena in question.

Lord Lindsay did not think it could be the corona that was seen, as a dark glass was used, and the corona as seen in eclipses could not possibly be seen through a dark glass.

Colonel Tennant agreed in this, and said he had looked for the projection of the moon's limb on the sky at the last eclipse, and was certain that it was not visible. It may have been seen sometimes, but was not then.

On future Solar Eclipses: by Rev. J. S. Johnson.

On Eclipse Photography: by Mr. Brothers.

Comparison of the Photographic Pictures of the Corona taken in 1869-70-71: by Mr. Ranyard.

Observations of Jupiter in 1871-72: by Mr. Browning.

This paper was illustrated by four beautiful coloured drawings of the planet, and the author explained that his attention had been concentrated on obtaining the most striking examples of the colouring of Jupiter, and that the details of configuration had therefore, received less attention, the nights chosen being those when coloration was strongest.

It was announced that two of the drawings would be reproduced in chromo-lithograph for the *Monthly Notices.*

The meeting then adjourned till November.

Errata in last report.

The occultations observed by Capt. Noble (p. 134) took place on April 18th, 1872. In line five for 10h. read 11h. Page 140, line 31, for *formal* read *journal.*

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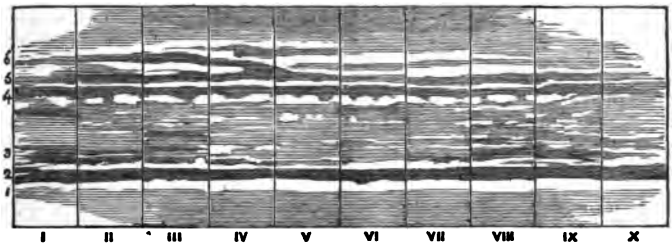
* March 6, 1867, *Astronomical Register*, Vol. V., p. 83.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

PLANISPHERE OF JUPITER, APRIL, 1872.



Sir,—The planet Jupiter is passing from our view, and exact observations of its belts must be deferred until it has passed its superior conjunction. Considerable changes, both in the disposition and colour of the belts, have occurred during the last three years. These changes have attracted much attention, and formed the subject of several interesting letters in the *Register*. Having observed the planet somewhat closely through the past twelve years, during which time it has been my habit to obtain a drawing on every available occasion, I trust that a rough sketch of the general arrangement of the belts, as exhibited in these studies, may be acceptable to some of your readers. Observations were commenced in the spring of 1859; at that time the planet was passing from opposition, and whether from great faintness in the markings of the belts, or inexperience in the observer, no lines on its surface could be perceived. In the fall of that year several studies were made in the early morning, when the belts were clearly visible, showing a great development of the southern dark belt, the northern being comparatively weak; the centre of the disc was then occupied by a band of light. From 1860 to 1863 there was a general tendency in the southern dark belt to increase in size and activity; while the northern, though it generally increased after opposition, continued the smaller, and was less given to change. The central band of light exhibited frequent spots, and was also somewhat reduced in breadth. From this period to 1867 the southern belt gradually lost its size and tendency to alteration in form, whereas the northern became more evident and active. In September of this year the northern belt was very dark, and brownish in colour, while the southern, though broader, was faint and gray; the centre of the planet being occupied by a brilliant white band. In 1868 the southern dark belt resumed its activity, exhibiting frequent spots of a darker tone, and the centre of the planet retained its white appearance. But between the end of this year and the opposition of 1869 great changes had taken place; the central light had disappeared, its place being occupied by a broad band of a yellowish copper colour, and the whitish portion of the disc was then, for the first time during these observations, on the north side of the northern dark belt. In October of 1869, colour took a very prominent part in the appearance of the disc, the southern belt being gray, while the northern was decidedly blue, and the whole surface of the planet seemed streaky from the number of small belts, which extended nearly to the poles. From this important period to the present time the general appearance has not greatly changed; the intensity of the copper colour has somewhat disappeared, and there has been considerable activity in the smaller belts and markings, especially towards the south; also a decided tendency to permanence and increase in the dark northern streak, No. 2. A glance at the lithograph will present these changes more readily to the eye than a page of description: there the tendency of the southern dark belt to maintain its preponderance till 1868 will be clearly seen, as also the strength of the central band of light in 1866-7, and its change to the copper tone in 1869.

An endeavour is made in the two larger drawings of the plate to represent the general features of the planet in April last, and as the second of these views was procured on the following evening, and at about the same hour, the two drawings present very nearly opposite portions of the planet's surface. It must not be understood that these drawings exhibit all that could be seen, but all that could be fairly drawn. In moments of steadiness of the atmosphere a minute mottling of the surface was perceptible, and the belts appeared fringed with smaller markings. But these glimpses were most tantalising, being utterly beyond the power of the eye to seize, or of the hand to follow. Few indeed have been the evenings since February last, when a choice 9-inch With-Browning Reflector was mounted, that a higher power than 200 could be used with advantage. However, during the last three months over forty drawings have been secured, and a short account of the method of arranging them for comparison may not be out of place.

When a definite mark has reappeared on several occasions, the drawing in which it is most central is chosen as a starting point, and the disc divided by a simple perspective diagram into five equal parts, the central division being called the first hour. A calculation is then made for each drawing, allowing 595 minutes to a revolution, and the time of each registered underneath the drawing. By this means the equator of the planet is divided into ten portions, each division answering fairly to an hour of revolution; thus one drawing can be readily compared with another, and changes become more evident, being presented to the mind in this simple but effective manner. When a sufficient number of drawings has been made, they are combined in the form of a planisphere, an example of which is given in the woodcut at the head of this letter, in which the fourth and eighth hours form the centres of the two drawings. This method of study has been found very interesting and instructive, as it exhibits, in the most conclusive manner, the bearing of the markings in one drawing with those of another, and occasionally develops the most unexpected connections. The whole surface is also presented at one view, and thus the peculiar features of any portion are made more impressive. The numbers at the side of the woodcut are adopted from Mr. Jos. Gledhill's arrangement, and are most convenient when referring to any particular belt. Hoping that your readers will not be offended at the length of this letter, but that it will be received as a humble effort to promote a systematic study of this King of the planetary world.

I remain,

Yours respectfully,

NATHL. G. GREEN.

3, Circus Road, St. John's Wood,
London: May 20, 1872.

ASTRO-METEOROLOGY.

Sir,—"Observer" is only treating us again to a few platitudes on the subject of the weather.

Of what conceivable scientific value, I would ask, can we consider a system, or theory, to be which connects the opposition of a planet with a barometric depression occurring 4 days afterwards? Why, if we are to admit this, and say that the effect of such opposition may be visible 4 days before, or after it occurs, this gives us 9 days altogether, or about a third of a month, during which we may look for a coincidence of some sort. Besides, before rushing into print, has "Observer" examined his former meteorological registers? because I fancy that I have somewhere heard or read that both Jupiter and Uranus have been in "opposition" before last January.

Nothing is more fallacious than a deduction drawn from insufficient data. To render "Observer's" hypothesis worth a rush, a long sequence of planetary "aspects" should be compared (*fairly*, not in 9 day periods) with the recorded barometric pressure at Greenwich. A few extremely doubtful coincidences prove nothing. Did your correspondent never hear of the appearance of the Goodwin Sands in the North Sea, contemporaneously with the building of Tenterden Steeple?

I am, Sir, obediently yours,

June 7, 1872. ANOTHER OBSERVER.

CONNECTION OF METEOROLOGY AND ASTRONOMY.

Dear Sir,—I have read with great interest, in your report of the Meeting of the Royal Astronomical Society, April 12, 1872, Col. Strange's paper; and the discussion which followed cannot but draw attention to the fact that Meteorology and Astronomy are closely connected, and that by the joint study of those sciences we may arrive at the practical results alluded to by the Astronomer Royal.

Since the publication of the "Edinburgh Temperature Record," by C. Piazzi Smyth, Astronomer Royal for Scotland; and the results arrived at, at the Cape of Good Hope, by Mr. Stone; together with the coincidence between the condition of the sun's surface and Toronto Rainfall, which has been clearly established; it seems to me impossible to avoid the conclusion that there is some *direct* or *indirect* connection between the sun spots and weather changes.

It may be of importance that additional observatories should be brought into existence to prosecute this work (and I regret the discontinuance of the Kew observations: three or four sun spot periods are needed to settle some important questions), but it is possible that materials exist already, which, if properly used, may help to show still further that important *practical* results may follow the establishment of such an observatory as Col. Strange contemplates.

But though such a work may not be carried into effect, something may be gained if your readers will send to the *Register* the annual means of any observations to which they have access.

For instance: the Table which you published in the *Register* of Nov., 1871, in the letter of W. Lawton, Esq., of Hull, teaches a lesson which, perhaps, he has not noticed himself.

Let the numbers of clear nights given in that table be thrown into a curve, and it will be seen that our Yorkshire friends have had a very cloudy period at the maxima and minima of sun spots ; and fine, clear weather between maximum and minimum. That table does not give the number of cloudy nights for 1871, the year of sun spot max. (or possibly the one immediately following). I doubt not, if he will now supplement that table, we shall find 1871 a cloudy year.

I will, with your permission, call attention to a few additional facts in this and a following letter, and hope your readers will furnish others.

Since the year 1854 a record has been kept by the Toronto Harbour Master of the height of the water in Lake Ontario, and as this lake is fed by rivers extending over a large territory, it gives an excellent method of estimating the general precipitation during that period.

The figures show in inches of annual mean height above a zero, which is an arbitrary mark, on a scale used for the purpose of measuring the water height.

TABLE IV.—ANNUAL MEAN HEIGHT OF WATER ON LAKE ONTARIO.

Year.	M. Height.	Year.	M. Height.	Year.	M. Height.
1854......	23.1	1860	18.3	1866	9.3
1855......	17.8	1861	27.4	1867	19.7
1856......	20.6	1862	26.6	1868	4.6
1857......	27.5	1863	20.4	1869	16.0
1858......	31.4	1864	18.0	1870	30.0
1859......	28.6	1865	15.0	1871	2.0(?)

By making a curve of these numbers we find that the state of our Lake's waters has been low about the time of sun-spot maxima and minima.

Truly yours,
A. ELVINS.

MERCURY.

Dear Sir,—By the appendix to the *Register* for the present month, I see the Rev. S. J. Johnson observed the planet Mercury on the evenings of the 25th March and 5th April.

Having a good aspect westward, my residence being situated on the extreme western limits of the town, I carefully searched for the planet on every opportunity during its last eastern elongation, but only on the evening of the 26th March, at 7·30, was I able to obtain a brief glimpse of this rarely seen member of our system, and this only through vapours which seriously interfered with the definition of an excellent 2-inch refractor by Thos. Cooke and Sons, equatorially mounted.

By far the most satisfactory view I ever had of this planet was about 6·15 on the evening of the 15th February, 1868, one of the clearest I ever remember. On that occasion, with powers from 50 up to 100 on the above instrument, I was able to observe the gibbous aspect of the planet, and also took note of its brilliancy. Part of the entry in my notebook is as follows: "With a power of about 50 the gibbous aspect of the planet is visible, and its disc very bright." On the following and succeeding evenings I was again on the look-out; but only on the 16th, from 6 to 6·15, was I able to get even a transitory sight through openings in passing clouds. I had, however, the additional satisfaction of seeing Mercury and Jupiter (the smallest and the largest members of the solar system), both just within the limits of the same field. I felt much disappointed that the very unfavourable weather of the present Spring allowed no good opportunity for turning a 7 feet silver-on-glass Newtonian upon it. Is it that the possessors of the numerous large and excellent Refractors (both public and private) are equally unfortunate as regards the weather that we hear so little of this planet? So far as I am aware the equatorial band-broken terminator or truncated horn, delineated by Schröter, observing with a Reflector, have not, as yet, been confirmed by English observers. The late Admiral Smyth, in the first volume of his "Celestial Cycle," page 97, writing of Mercury, states: "I have watched him in the telescope through all his various aspects from the full gibbous to the thin crescent, but he was always far too dazzling for the detection of any penumbræ or luculi of the supposed dense atmosphere; therefore, of the truncated horn of his cresent or the mountains, or their probable height and effect in modifying the intensity of heat, can offer nothing from personal observation. My large instrument was not the best adapted for the work; since, though achromatics are most convenient from their reduced focal length, they are decidedly disadvantageous in those cases where it is necessary to command distinctness of vision under low magnifying powers.

Permit me, in conclusion, to suggest the observation of Mercury, whenever and wherever practicable, to some of the owners of silver-on-glass Reflectors larger than my own (7-in. by 7-ft.)

I remain, dear Sir, yours truly,

WILLIAM LAWTON.

5, Victoria Terrace,
Victoria Street, Derringham,
Hull: 14th June, 1872.

QUERIES.

Can any of your readers give me answers to one or both of the following questions?

1. What was the total eclipse in England next preceding that of 1715? Was there nothing between that and the Black Saturday of 1433?

2. Is a 3-inch achromatic sufficient to show indications of the markings on Mars about the time of an opposition?

A SUBSCRIBER.

THE NEBULA IN THE PLEIADES.

Sir,—Reading in the June *Register* a statement that this object has been unsuccessfully searched for with an 8-inch achromatic, and a query as to whether the nebula has dispersed itself among the stars of this cluster, I think it should be known that since December, 1869, this object has always been seen without any difficulty in the 12¼ speculum, and that during the first three months of the present year, the Pleiades have received more than usual attention, as I have been laying down a rough chart of the relative position of its components, and of the nebula. Among them is a large, oval, ill-defined object, with the star Merope a little within the northern and smaller end, the faint haze extending sufficiently far north of this star to include a pair of very faint stars, making a neat double with a low power; from Merope it extends a long way south, a little preceding, and it can certainly be traced from the pair of stars just mentioned a distance of 25 minutes southwards.

The preceding remarks refer to its appearance as seen in a comet eye-piece of large field and low power, not more than about 45 : with higher powers it is seen with difficulty, and, in fact, might be easily missed altogether, and this is especially the case with an equatorial telescope accurately driven by clockwork; for, as I have often found after viewing the nebula with the comet eye-piece, on applying an achromatic eye-piece of about 150, it was invisible. Notwithstanding, I knew it was central in the field, and it was only after stopping the clock, or moving the telescope, that it could be perceived, and even then with great difficulty. Here, then, we have a very probable explanation of many of the supposed changes which this nebula has been supposed to undergo, although observed with large and well-mounted instruments; and it appears more than ever certain to my mind, bearing in view the extreme tenuity and extent of this object, that we see it now exactly as it has existed for many hundreds and, perhaps, thousands of years.

I am, yours truly,

Richmond: June 10, 1872. CHARLES GROVER.

SUN.

Greenwich, Noon. 1872.	Heliographical western longitude of the centre of		Heliographical latitude the sun's disc.	Angle of position of the sun's axis.
	°		°	°
July 1	144.71	+180 δ ξ	+3.16	357·73
2	157·96		3·27	358·18
3	171·21		3·38	358·64
4	184·46		3·48	359·10
5	197·71		3·59	359·56
6	210·96		3·69	0·02
—				
7	224·21		+3·80	0·47
8	237·46		3·90	0·93
9	250·71	+190 δ ξ	4·00	1·38
10	263·96		4·10	1·84
11	277·21		4·20	2·29
12	290·46		4·30	2·74
13	303·71		4·39	3·19
—				
14	316·96		+4·49	3·64
15	330·20		4·58	4·08
16	343·45		4·67	4·53
17	356·70		4·76	4·97
18	9·95		4·86	5·41
19	23·19	+200 δ ξ	4·94	5·85
20	36·44		5·03	6·29
—				
21	49·68		+5.12	6·72
22	62·93		5·20	7·15
23	76·17		5 28	7·58
24	89·42		5·37	8·01
25	102·66		5·45	8·43

26	115·91		5·53	8·85
27	129·15		5·61	9·26
—				
28	142·39		+5·68	9·68
29	153 63	+210 δ ξ	5·76	10·09
30	168·87		5·83	10·50
31	182·11		5·90	10·90

Assumed daily rate of rotation, 14°·2 + δ ξ.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JULY, 1872.

By W. R. Birt, F.R.A.S., F.M.S.

The lists for April and June, 1871, are available for observation in July, 1872. On p. 127 of the May number of the present volume, the value of supplement of ☾ — ⊙ from the 21st to the 30th of April is quoted as 155° 38,′ diminishing to 53° 45.′ On July 7 the value of supplement ☾ — ⊙ is 155° 43.′ In vol. IX., p. 149, the values are for June 20 and 30 respectively 148″ 10·3′ and 22° 7·5.′ On July 18, 1872, supplement ☾ — ⊙ = 22° 29·0.′ The two lists, April and June, may therefore be combined for the purpose of indicating those objects that may be observed between July 7 and 18, inclusive.

Seventh Zone of objects from North to South.

Cepheus, Macrobius, Proclus, Taruntius, Messier, Goclenius, Cook, Reichenbach, Rheita, Steinheil, Hagecius.

The objects given in this and the preceding six zones are found on the western quarter of the Moon's visible hemisphere, the eastern boundary of which is 25° of west longitude. They are so situated as to be seen under oblique visual angles, and may be employed as admirable studies of variation of *form*, resulting from alternate recess and approach from and to the eye, the effects of libration in longitude. When the Moon is in Perigee or Apogee these objects are in their normal positions, as seen from the earth, so far as their distances in longitude from the centre of the disk is concerned. When the Moon is passing from Perigee to Apogee they are east of their normal positions, and are more favourably placed for observation than when the Moon is passing from Apogee to Perigee, during which time they are seen more westwardly nearer the limb and further from the eye. This is the case between the 7th and 18th of July, the Moon passing from Apogee to Perigee. Careful records of such studies as above alluded to are very desirable; and the more so as it is highly probable that the floors of large formations—Petavius, for example—may vary in tint, light or dark, independently either of illuminating or visual angles. Any variations of tint dependent upon the surface being viewed more or less obliquely, under increasing or decreasing oblique light, must have regular periods of increase and decrease of intensity; and it is of the utmost importance that these periods should be well determined, as well as the regular progression of the tint curve of the floor dependent upon the Sun's altitude above the horizon of the formation, in order that a clear line of demarcation may be drawn between, *first*, absolute variation of tint dependent upon solar influence; *second*, relative variation of tint dependent upon oblique vision; *third*, absolute variation of tint dependent upon lunar forces in active operation.

ASTRONOMICAL OCCURRENCES FOR JULY, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. α Lyræ.
Mon	1		Sidereal Time at Mean Noon, 6h. 39m. 22·87s.	4th Tr. I.	9 3	11 51·3
Tues	2		Sun's Meridian Passage, 3m. 46·03s. after Mean Noon	1st Tr. I.	9 18	10 47·4
Wed	3			1st Ec. R.	9 23 20	11 43·4
Thur	4	2 34 23 30	Conjunction of Moon and Mars, 0° 58′ S. Conjunction of Moon and Venus, 1° 58′ S.			11 39·5
Fri	5	6 24	● New Moon			11 35·6
Sat	6	11 20 14 35 23 49	Conjunction of Moon and Mercury 1° 55′ S. Conjunction of Moon and Uranus, 3° 22′ S. Conjunction of Moon and Jupiter, 3° 39′ S.			11 31·6
Sun	7	8 34	Conjunction of Uranus and Mercury, 1° 19′ N.			11 27·7
Mon	8					11 23·8
Tues	9	11 13 9 37	Opposition of Saturn Near approach of *i* Leonis (6)			11 19·8
Wed	10	6 42	Conjunction of Jupiter and Mercury, 1° 12′ N			11 15·9
Thur	11					11 12·0
Fri	12					Moon. 5 11·3
Sat	13	7 48	☽ Moon's First Quarter			5 54·5
Sun	14	9 32	Near approach of 2 Libræ (6)			6 40·1
Mon	15	17 47	Superior Conjunction of Venus Saturn's Ring: Major Axis=41″·60 Minor Axis=16″·92 Illuminated portion of disc of Venus 1·000 Illuminated portion of disc of Mars 0·992			7 29·1

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Tues	16	9 42 10 54	Occultation of B.A.C. 5395 (6) Reappearance of ditto			Moon, 8 22·8
Wed	17	11 28 13 5	Near approach of 39 Ophiuchi (6) Occultation of θ Ophiuchi (3½)			9 21·9
Thur	18		Sidereal time at Mean Noon, 7h. 46m. 24·35s. Sun's Meridian Passage, 5m. 56·58s. after Mean Noon			10 25·5
Fri	19	8 13	Conjunction of Moon and Saturn 3° 12′ N.			11 31·7
Sat	20	1 53 16 6	○ Full Moon Occultation of B.A.C. 7197			α Lyræ. — 10 36·6
Sun	21	18 3 11 38 12 37	Conjunction of Uranus and Venus 0° 31′ N. Occultation of B.A.C. 7550 (6) Reappearance of ditto			10 32·6
Mon	22	14 27 15 37 15 56 16 47	Occultation of τ^1 Aquarii (6) Reappearance of ditto Occultation of τ^2 Aquarii (4) Reappearance of ditto			10 28·7
Tues	23	17 41	Conjunction of Sun and Uranus			10 24·8
Wed	24	2 43	Conjunction of Mercury and α Leonis (3·3m. E.)			10 20·8
Thur	25					10 16·9
Fri	26	19 18 13 46 14 46	☾ Moon's Last Quarter Near approach of 64 Ceti (6) Near approach of ξ^1 Ceti (4½)			10 13·0
Sat	27					10 9·0
Sun	28	14 22	Conjunction of Jupiter and Venus 0° 40′ N.			10 5·1
Mon	29					10 1·2
Tues	30	16 14	Near approach of 121 Tauri (6)			9 57·2
Wed	31					9 53·3
AU Thur	G. 1	22 36	Conjunction of Moon and Mars 2° 17′ S.			9 49·4

MOON.

LIBRATION. **SUN'S PLACE.** **TERMINATOR.**

Selenographic long. and lat. of the point
on the moon's surface which has the
Earth's | *Sun's*
centre in the zenith.
Greenwich, Midnight.

Selenographical longitude
of the points in latitude 60°
N., 0° and 60° S., where the
sun's centre rises or sets.

						SUNSET.	
	long.	lat.	long.	lat.	60° N.	0°	60° S.
1872.	°	°	°	°	°	°	°
						SUNRISE.	
July 9	—4·5	—6·7	+129·2	+0·92	+37·5	+39·2	+40·8
10	5·6	6·7	116·9	0·94	25·3	26·9	28·6
11	6·5	6·4	104·7	0·96	13·0	14·7	16·4
12	7·1	5·8	92·5	0·98	+0·7	+2·5	+4·2
13	7·5	5·0	80·2	1·00	—11·5	—9·8	—8·0
—							
14	—7·4	—3·8	+68·0	1·03	—23·8	—22·0	—20·2
15	7·0	2·4	55·8	1·05	36·0	34·2	32·4
16	6·1	—0·8	43·6	1·07	48·3	46·4	44·5
17	4·9	+0·9	31·4	1·09	60·5	58·6	56·7
18	3·3	2·6	19·2	1·12	72·7	70·8	68·9
19	—1·3	4·1	+7·0	1·14	—84·9	—83·0	—81·0
20	+0·7	5·3	—5·2	1·16		SUNSET.	
—							
21	+2·9	+6·2	—17·4	+1·18	+74·7	+72·6	+70·6
22	4·7	6·6	29·6	1·20	62·5	60·4	58·4
23	6·2	6·6	41·7	1·22	50·3	48·3	46·2
24	7·3	6·1	53·9	1·23	38·2	36·1	33·9
25	7·8	5·4	66·1	1·25	26·0	23·9	21·7
26	7·9	4·3	78·4	1·26	13·8	+11·6	+9·5
27	7·5	3·1	90·6	1·27	+1·6	—0·6	—2·8
—							
28	+6·8	+1·8	—102·8	—1·29	—10·6	—12·8	—15·0
29	+5·8	+0·3	—115·0	+1·30	—22·8	—25·0	—27·3

These longitudes are reckoned, according to the custom of selenographers, from the central first meridian 0 both ways, + in the direction of the preceding, — in that of the following edge. As, however, the manner of reckoning has several practical inconveniences and disadvantages, observers of the moon will perhaps not object to a little innovation, which supplies a remedy without interfering with established custom. It is proposed, while retaining or discontinuing at pleasure the employment of selenographical longitudes λ, to introduce the use of their complements 90° —λ, and to call the latter "colongitudes." This term and the notation "90°—λ," will prevent any misinterpretation or misunderstanding. On the map the colatitude of the preceding edge is 0°, that of the central meridian 90°, and that of the following edge 180°. The convenience of the little innovation will perhaps be most readily tested and appreciated by comparing the table previously given with the following, in which the longitudes are supplanted by their colongitudes :—

		Earth's place.		Sun's place.		Colong. of Terminator.		
		colong.	lat.	colong.	lat.	60° N.	0°	60° S.
		°	°	°	°	°	°	°
July	9	94·5	−6·7	320·8	+0·92	52·5	50·8	49·2
	10	95·6	6·7	333·1	0·94	64·7	63·1	61·4
	11	96·5	6·4	345·3	0·96	77 0	75·3	73·6
	12	97·1	5·8	357·5	0·98	89·3	87·5	85·8
	13	97·5	5·0	9·8	1·00	101·5	99·8	98·0
	—							
	14	97·4	−3·8	22·0	+1·03	113·8	112·0	110·2
	15	97·0	2·4	34·2	1·05	126·0	124·2	122·4
	16	96·1	−0·8	46·4	1·07	138·3	136·4	134·5
	17	94·9	+0·9	58·6	1·09	150·5	148·6	146·7
	18	93·1	2 6	70·8	1·12	162·7	160·8	158 9
	19	91·3	4·1	83·0	1·14	174·9	173·0	171·0
	20	89·3	5·3	95·2	1·16		SUNSET.	
	—							
	21	87·1	+6·2	107·4	+1·18	15·3	17·4	19·4
	22	85·3	6 6	119·6	1·20	27·5	29·6	31 6
	23	83·8	6·6	131·7	1·22	39·7	41·7	43·8
	24	82·7	6·1	143·9	1·23	51·8	53 9	56 1
	25	82·2	5·4	156·1	1·25	64·0	66·1	68·3
	26	82·1	4·3	168·4	1·26	76·2	78·4	80·5
	27	82·5	3·1	180·6	1·27	88·4	90·6	92·8
	—							
	28	83·2	+1·8	192 8	+1·29	100·6	102·8	105·0
	29	84·2	0·3	205·0	1·30	112·8	115·0	117·3

THE PLANETS FOR JULY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	7 17 55	+24 2	5″·0	0 38·5
	15th	9 6 52	+17 58	5″·8	1 32·0
Venus ...	1st	6 30 39	+23 39½	9″·6	23 47·4
	16th	7 45 16	+22 9	9″·6	0 6·7
Saturn ...	1st	19 20 11	−21 56	16″·6	12 38·7
	15th	19 15 48	−22 5½	16″·6	11 39·3

Mercury towards the middle of the month will be well situated for observation, setting an hour after the sun, the interval decreasing.

Venus is too near the sun to be worth observing. She rises after sunset after the 11th.

Saturn is still very low, but may be fairly observed.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June, 1872.

Clark, Miss
Morton, Rev. J.

To July, 1872.

Loder, E. G.

To Aug., 1872.

Seecomber, Dr.

To Sept., 1872.

Guyon, G.
Jackson-Gwilt, Mrs.
Wright, Rev. W. H.

To Dec., 1872.

Buffham, T. H.
Clark, J. W.
Hubbeosty, Rev. R. C.
Jefferies, J.
Lawton, W.
Squire, H.
Young, L. S.

NOTICE.

JOHN BROWNING begs respectfully to inform scientific gentlemen and the public generally, that he has taken the Premises, No. 63, Strand, opposite Bedford Street. These premises he will open as a West-End branch of his business on the 18th of March. In a Show-room on the ground floor there will be every convenience for testing, or seeing in action, Microscopes, Spectroscopes, Astronomical, Electrical, and other Philosophical Apparatus. There are light workshops on the premises. Communication has been established by electric telegraph with the Factory at 111, Minories. JOHN BROWNING, Optical and Physical Instrument Maker to the Royal Society, the Royal Observatories of Greenwich and Edinburgh, &c., &c., &c., 63, Strand, W.C.; 111, Minories, E.; and 6, Vine Street, E.C. Specialities, Spectroscopes, Astronomical Telescopes, Polariscopes, Microscopes, and Electrical Apparatus.

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TO CORRESPONDENTS.

SMYTH'S CELESTIAL CYCLE.—Our Sydney Correspondent, whose exact address we have mislaid, is informed that we can procure a good copy of the above work for him if he still wishes to have it.

We are obliged to postpone several interesting papers through want of space.

NOTICE.—It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 116. AUGUST. 1872.

OBSERVATIONS OF JUPITER FROM DECEMBER, 1871, *TO MAY*, 1872.

By John Browning, Esq., F.R.A.S.

Read at the Royal Astronomical Society, June 14th, 1872.

From the drawings of Jupiter which I have made since December, 1871, I have selected only four to bring before the notice of the Society. These drawings were made on the following dates:—No. 1 on December 4th, 1871, at midnight; No. 2 on January 14th, 1872, at 7 p.m.; No. 3 on March 3rd, 1872, at 8.45 p.m.; No. 4 May 5th, 1872 at 9.15 p.m.* The drawings made during the winter months are somewhat deficient in detail, as compared with those made recently; but this I do not doubt is principally the result of the bad definition due to very unsteady air, as the first drawing mentioned, that made on December 4th, contains nearly as much detail as those made recently. The markings are, however, so complex that when the air is unsteady they defy all attempts to draw them accurately. I had some tolerably good views of the planet earlier than December of last year, the tawny color of the equatorial belt seemed to me stronger than I had previously seen it. As, however, a well known observer, who had previously made color observations of Jupiter, did not agree with me, I preferred making continued a series of observations before giving a decided opinion on the subject. Subsequent observations have convinced me that my conclusion was correct, and I have since been fortified in this opinion by the statement of our late President Mr. Lassell. On every occasion when the definition has been good, I have been able to make out light markings flecking the tawny colored surface of the equatorial belt. The drawings I have made do not shew any remarkably symmetrical forms. In several instances I had drawn nearly oval markings or turretted forms on the southern edge of the equatorial belt; but using the highest power the night would bear, and watching for fitful intervals of the best definition, I always found these exceedingly regular forms were incorrect, and had to modify them, for this reason. I rather distrust the drawings made on the 3rd of March, the markings on the dark belt south of the equator present forms similar to those we see at times in white cumulous clouds previous to a thunderstorm. I believe that could I have obtained clearer views of the planet, I should not have left these markings quite so regular as they now appear in the drawings. The light belts frequently incline at a considerable angle from the poles towards the equator of the planet. The belt shown on the drawing No. 4, made on May 5th, at 9.15 p.m., G. M. T. makes an angle of nearly 25° with the equatorial belt; a number of shorter markings also about the same angle stretch some distance into the tawny colored equatorial belt; these I at first drew of a turretted form and only very close examination convinced me that they had the inclination I have now given to them. The darker belts have varied from dark warm or cool grey to purple madder or madder brown, but towards the poles of the planets the belts have been usually of a blueish grey, while close to the poles the blue color has been very decided. I have made several observations of the spectrum of the planet, but though I have 12-in. of aperture, I did not find this sufficient to enable me to see more than the dark absorption bands in the red portion of the spectrum, with which most observers are now probably familar. Though I cannot make out any differences in the appearance of the spectrum sufficiently marked to enable me to draw or describe them, yet I strongly suspect a change in the spectrum which a larger aperture giving more light would enable me to bring out.

---

* Two of the four drawings are reproduced in colors in the *Monthly Notices*.

NOTICE OF A LECTURE BY PROFESSOR G. B. DONATI ON "AURORÆ BOREALES AND THEIR COSMICAL ORIGIN."

(*Concluded from page* 148.)

Let us consider only the phenomena of auroras. These are produced almost invariably in the polar regions; since there the action of the terrestial magnetism which may combine with the cosmical, whose actiou never ceases to operate in a certain degree, is more energetic; but if such a degree is by some means augmented, it is evident that there will been corresponding augmentation of the auroral phenomena, which will extend themselves so as to become visible even in places more distant from the poles. Donati proceeds to notice the investigations of Wolf in 1859, and Carrington, in his work published in 1863, on the influence of Jupiter on the number of the sun spots; and of Loomis, who has recently taken into consideration the effect of the combined movements of Jupiter and Saturn, which every ten years (very nearly) are found in a straight line passing through them and the sun. There is also another period. Two revolutions of Saturn round the sun are accomplished in nearly the same time as five revolutions of Jupiter, so that in about 59½ years these planets return to exactly the same positions relatively to the sun. These periods have indeed a surprising correspondency with those which we have already remarked as belonging to the greater or less frequency of grand auroras. * * * Science is therefore not adverse to admit that the greater or less development of these phenomena may to a great extent depend upon the simultaneous and combined action of the above mentioned two planets. Donati next refers to a like probable influence in the case of all the other planets, but remarks that the necessary researches to establish this are both difficult and as yet wanting. He proceeds to observe that the cosmical theory of auroras not only explains their periodicity, but as he thinks, may account for another circumstance connected with them, for which no theory as yet has offered any explanation : that is that for all places however widely differing in longitude, auroras, at least the greater displays, begin always after sunset, attain their maximum between 10 and 11 p.m., and end a little after midnight ; the very great ones, however, last even all night. * * * How could this happen if the aurora arose from electric phenomena, dependant only on conditions of our atmosphere ? Were it so, it is not intelligible why they should be developed first in the east, and then in the west: why, that is, their phenomena transport themselves successively from one place to another ; whilst, on the contrary, the atmosphere should be found in a certain degree of excitement ; the maximum for example, in a given instant which ought to be *simultaneous* everywhere ; and, consequently, the maximum of the phenomenon ought to be manifested in different hours for those places which at that instant have already night, but different hours of the night : only in different places the phenomenon would be seen in different positions with respect to the horizon.

But if, instead, we admit magnetic cosmical currents, and imagine for example, a certain current going towards or leaving the sun ; then it is easily conceived that in our atmosphere (whether *cosmical* or *meteorological*), certain phenomena could only happen in those parts which take a certain position and direction with respect to that current ; and, consequently, the various phenomena would successively become visible under the different meridians, as by the divisional movement of the earth those came to assume in succession the same position and direction with respect to the said current. * * * Donati adverts next to the principle of the spectroscope, and its application to investigate the nature of auroras. He says of the bright green line, that not being precisely that of iron, it cannot with certainty be affirmed that where the aurora occurs there are particles of iron present. Nevertheless, the experiments of Mr. Tréve show that the bright lines of certain substances change when they are brought under the action of magnetism ; and since the aurora is a magnetic effect, the green line observed in its light might well belong to iron, notwithstanding it be a little displaced from its ordinary position. But it must be confessed data are still wanting for science to speak positively : only, I will say, that it is very probable that in the higher regions of the atmosphere there are many particles and vapours of iron, since the falling stars, minute fragments of cosmical matter, which in general burn and are consumed precisely in those regions, are mostly composed of iron, as is proved by such as having reached the earth, have been chemically analysed.

It is well, lastly, to remark that, from all I have thus far discovered about it, it may be reasonably inferred that there is beginning to rise on the scientific horizon, a *new* (that is, *cosmical*) meteorology, which may not a little aid the progress of that *ancient* meteorology, which although born so long ago, is yet altogether in its infancy.

Florence, February 15, 1872.

RAIN OF SAND IN SICILY.

BY PROFESSOR G. DE LISA.

Professor G. De Lisa, of the Observatory of Palermo, has printed an account of the great fog and the rain of sand, which occurred in Sicily in March last, from which the following brief notices are extracted.

March 6th.—Unusual meteorological condition of the atmosphere. Slightly reddish aureole round the sun; barom. falling.

7th.—Dense fog; barom. still falling; winds variable, and from S.

8th.—Bar. pressure still lessening; at 9 a.m. a high and dark fog seen above the cumuli, which at 4 p.m. spread over the country; winds chiefly S. and S.W.

9th.—Pressure at a *minimum* of m.m. 745.09; heavens obscured; fog universal; an ashy-reddish colour prevails everywhere; wind strong, S. and S.E.; oppressiveness and languour; sea disturbance; a very fine red dust deposited everywhere; 9 p.m. bar. rising; soon after the air became calm.

10th.—The dense fog continues; at 9 a.m. a great quantity of sand was gathered up on the terraces of the Observatory; the sun seen for a few minutes through the fog with a well-defined white disk, beheld by the unprotected eye with impunity; in the afternoon rain with lightning and thunder; setting sun looked like the full moon in its quiet splendour; 9 p.m. rain mingled with a large quantity of fine dust.

11th.—Dense fog; sun invisible.

12th.—Fog, but not dense as before; it is real vapour of water, and has not the brown colour of the past days.

In general, it is to be remarked that the dense fog while it lasted was very high, more elevated than the hills and clouds. There was nothing very exceptional in the hygrometric state of the air; the highest temperature did not exceed twenty degrees. When the Sirocco blows in Palermo the predominant meteoric conditions are very different from those above noticed. They are not unseldom accompanied by dry fogs. It is evident that a great tempest gave rise to the phenomena we have described.

M. De Lisa next refers to M. H. Tarry, of Paris, who in May, 1870, presented to the Academy of Sciences a note in which he stated that such storms, or *cyclones*, as above described, could be foretold. At certain epochs of the year, and principally in February and March, cyclones are suddenly formed in the North of Europe, and descend rapidly towards Africa, where they form sand-storms in the Sahara, and raise enormous quantities of the desert sand to the higher regions of the atmosphere. Other cyclones are formed in America near the equator, and arrive at the N.W. of Europe . . . whence descending to Africa. they afterwards return from the S. to the N., charged with fresh masses of sand.

Writing to De Lisa on February 28, 1872, M. Tarry remarked that a cyclone which descended on Europe from 24th to 27th January had then its centre on Sicily; and he believed that it would return from the S. about the 3rd *or* 4th *of March*, and that it was very probable that *a fall of sand would be observed in Sicily or Spain*. . . . Besides that this provision of M. Tarry did not fail, there is no doubt that the cyclone observed, and the fallen sand were of African origin. The phenomenon was also observed in the southern parts of Sicily, and the desert sand was abundantly deposited everywhere—a very fine and light powder, and of the colour of pounded terra cotta.

The Professor proceeds to notice various remarkable solar phenomena which occurred on the 5th March, and which were observed in various places by P. Denza, P. Secchi, and Tacchini; also fine zodiacal light, auroras, and magnetic perturbations about the same period: observing that in a mass of facts it is necessary to distinguish those amongst them which owe their origin more proximately to solar movements, from others, which though at first they were similarly produced, after a time following their evolutions have lost the importance of such an immediate reference. There is a close link between solar eruptions and auroras, phenomena rapidly developed that do not involve researches for a distant origin. But the study of storms is more difficult. The magnetism of our earth, violently disturbed by the solar movements, must act powerfully upon atmospheric currents, and occasion not light derangements, which when they find favourable local meteoric conditions, give rise to storms which afterwards are propagated everywhere. Here the necessity and the action of time is more important. A storm may be in the vigour of its commencement, when the cause which produced it has already ceased, the greatest circumspection is therefore necessary in treating of such important questions. An example is afforded by this dense fog. Some might think there was an evident connection between it and the solar phenomena, auroras, and zodiacal light observed at the same epoch; but they would be mistaken. The solar eruptions of the 5th March may very likely originate tempests, even as they have originated auroras, and the strengthening of zodiacal light; but they have no direct relation to the tempests of those days, which attracted the attention of M. Tarry as far back as the end of February, so that he was able with confidence to predict the arrival of the tempest in Sicily, accompanied by the rain of sand, twelve days beforehand.

A study more minute and accurate of the various cosmical and meteoric phenomena will lead to the splendid resolution of many problems; and, perhaps, from the appearances of the sun we may be able to deduce the changes which shall affect our earth in not short periods of time.

PROFESSOR DONATI ON THE AURORA OF 1872.

Professor Donati has published a note on "Some Phenomena which manifested themselves on the telegraphic lines during the Great Aurora of the 4th of February, 1872," &c. The following is extracted from the Professor's paper:—

"The accidental currents, and the corresponding perturbations were greater on the lines whose direction is from east to west, than on those whose direction is from south to north; and that also when the lines from east to west are much shorter than those from north to south. . . . . This fact had been noted by Sig. G. Masi [Inspector] also on the occasion of the great aurora of the 24th of October, 1870; and has likewise been confirmed by MM. Sureau and H. Tarry, for the telegraphic lines of France.

Very many, moreover, were the inversions of direction, and very many the changes of intensity that the currents underwent which traversed the telegraphic wires at the time of the aurora. . . . From the things thus far related, I think, then, that I may conclude with M. Tarry that the perturbations of the telegraphic lines were *in general simultaneous*.*

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* In Italy, France, and Turkey.

Nevertheless, on this very important point more extensive and minute researches would be desirable, than what have been hitherto made ; inasmuch as the perturbations on the telegraphic wires succeeded each other in an almost continuous manner, and even small errors in the time noted, or in the observed deviations, might make a coincidence appear, even where it does not really exist.

To prove the *general simultaneousness* of the electric disturbances which are manifested on telegraphic lines during auroras would be the more important, since it seems sufficiently established by experience that the luminous phenomena depending on auroras are by no means simultaneous, but, on the contrary, are displayed first in the more eastern places, and afterwards in those more to the west.

Donati adds in conclusion that a note he had just seen from M. Troerster, Director of the Observatory of Berlin, confirms the results he has above indicated. In Germany, also, the perturbations were greater on telegraphic lines lying along the parallels, than on those lying along the meridians. There, too, they had inversions of the current, and constant currents, which happened in times corresponding with those observed in Italy, France, and elsewhere. These phenomena, remarks M. Troerster, which appear to have intimate relations, even at very great distances, deserve to be studied. both in a *chronographic* and a *dynâmic* respect, with more care than has hitherto been bestowed upon them."

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE NEBULA IN THE PLEIADES.

This object was seen as a large bright nebula in 1859. In the next year Tempel, who had so seen and described it (he had taken it at first for a comet), could just see it with the 6-ft. refractor at Marseilles. If we combine these facts with the circumstance that Mr. Grover, whose acuteness of vision is well known, can only just perceive it with so moderate a power as 150 on a fine 12¼-in. reflector, one does not quite perceive why it should " appear more than ever certain to his mind that we see the nebula now exactly as it has existed for many hundreds and perhaps thousands of years." Even without the known facts which led Sir J. Herschel to include this nebula among variable objects (" cases in which a nebula, undoubtedly such, has either disappeared and reappeared in the same place, or has undergone some remarkable change of brightness ") one can scarcely see how the observation of a nebula for 2½ years should make us altogether confident as to its condition " many hundreds and perhaps thousands of years ago." If hundreds and thousands, why not millions and billions of years ? I fail to see how the 2½ years can extend themselves so largely without possessing the capacity for extending themselves indefinitely.

Faithfully yours,
FACTS RATHER THAN FANCY.

PROCTOR'S CHART OF 324,198 *STARS.*

Sir,—I am not quite sure whether Mr. Backhouse in speaking of the tendency of stars in this chart to arrange themselves in circles having the pole at their centre, refers to the great rich projections from the Milky Way in Perseus, Auriga, and some other places, or to a more minute and, as it were, textural feature of the chart.

If he refers to the former, I can unhesitatingly say that the feature is a real one, though the actual position of these great star streams is of course a mere coincidence. Wollaston recognised these projections as Milky Way features, and they are recorded in the star maps of the Society for the Diffusion of Useful Knowledge, as also in my Gnomonic Charts, Constellation Seasons, and elsewhere. In my large atlas I discarded them, because I followed Sir J. Herschel's descriptions and drawings of the galaxy, and he did not recognise them. But they exist, and it is not the least remarkable result of the process of charting I employed that not only does it show the Milky Way actually plotted out by stars of the brighter orders of magnitude, which according to the Grindstone Theory of the Universe ought to show scarcely any marked aggregation towards the galactic zone, but it brings out features which can only be recognised by persons possessing extraordinary acuteness of vision.

These results, though according generally with Struve's statistical results, go yet very much farther, and, rightly understood, demonstrate the existence of *real* as distinguished from *optical* aggregations of stars in the milky way region.

But if Mr. Backhouse's remark relates to a minuter feature—an apparent tendency in certain places to concentricity or radiality of stars—then we have to do with a textural peculiarity resulting partly (in all probability) from the way in which the stars of Argelander's series were observed, and partly from the nature of my process of charting. That in different "sweeps" there should have been a greater or less degree of space-penetration will seem by no means unlikely, if we consider how the best observers find their visual powers varying as their work proceeds. There is not uncommonly a gradual increase of power for some considerable time after such work begins, followed after a time by a gradual accession of eye weariness. The effect of this on the charts will be obvious. Then, again, only certain parallels are swept by the centre of the field (Argelander and his assistants used a rather large field), and this would have an effect, though perhaps a slight one.

As to the charting, I would invite those who possess copies of my chart to examine it closely in R. A. 5h. 20m., and about two inches from the circumference. Here they will find traces of the pencilling (the only traces of the kind in the whole map). Now, if they consider that such minute spaces as are here seen were filled in repeatedly by eye-draft from the corresponding spaces in Argelander's chart, they will see at once that no star could by any possibility be set more than the minutest fraction of an inch out of its true place, and they will thus recognise that *for its main purpose* the chart can be implicitly relied upon, it is, indeed, much more accurate than was by any means necessary *for that purpose.* Nevertheless, the possibility of a minute textural peculiarity resulting in certain places will be at once recognised. The circles and radial lines pencilled in before the work of charting began, seemed to the eye perfectly regular, concentric, and truly distanced, but when one sets down hundreds of thousands of stars, in tens of thousands of spaces, the minutest departure from regularity will reveal itself. Even if the pencil point has been a little blunt at one part of the work, and has so made thicker strokes than elsewhere, the effect will be recognised.

Such considerations will perhaps serve to explain the occasional occurrence of a slight textural peculiarity, which does not in the least affect the main teaching of the map, a teaching which amply repays me for the 400 hours devoted to the construction of the chart.

But even this peculiarity is partly subjective. Let any one cut out a circle about four inches in diameter from a sheet of paper large enough to hide the circular boundary of the map, and place the sheet on different parts of the chart, especially where the peculiarity noticed by Mr. Backhouse seems most obvious, and it will be found that the concentricity or radiality becomes much less startling.

Dr. De la Rue has advised me to get the chart copied of its full size by the photoheliotype process. I fear, however, the cost would be too great, and it need hardly be said that any sale such a chart can have must be quite insufficient to cover the photographic expenses.

Your readers may be interested to learn that the processes of star gauging which the results of my charting led me to suggest are likely to be set on foot on a tolerably extensive scale. I have already received promises from observers using, or about to use, a 20-inch reflector, a 12-inch reflector, and an 8-inch refractor. More recruits, with these and other space penetrating powers, are wanted. There need be no fear of their work overlapping, indeed, it *ought* to overlap, that results may be compared. I hope next spring to complete the survey of the region covered by Taurus, Auriga, Gemini, and parts of Orion and Perseus, with the 4⅗-inch refractor lent me for the purpose by the Astronomical Society. (Surveys with small apertures, from 3½ inches upwards, are as important for completing the evidence as those with the largest.*) But the greatest encouragement I have yet received has come from the Astronomer Royal, who speaks even of applying the powers of the great equatorial at Greenwich to the gauging of the star depths at suitable times. I am satisfied that when once the work has been fairly set on foot, and results begin to be available for study, it will be quite unnecessary for me to urge any arguments in its favour.

RICHARD A. PROCTOR.

SPECTRUM OF THE ZODIACAL LIGHT.

Sir,—In your Number 115, p. 166, you report, with regard to my paper read at the Royal Astronomical Society, and describing my recent observations of the spectrum of the Zodiacal Light at Palermo, that Mr. Proctor (one of the Secretaries of the Society) "thought the observations rather doubtful, from Professor Smyth having used so many as nine prisms. With three or five he would have had a better chance upon such objects." After hearing which damaging statement the Society passed on to the next paper.

For Mr. Proctor's sake, I hope that your reporter has made some error in taking down his remark; but *I* am required to deal with the words actually printed by you and already misleading your readers as to the worth of the results arrived at by me, touching an astronomical phenomenon whose exact nature is at this moment a matter of keen disputation all over Europe, and throughout America as well.

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* It is important that the fields of view should be made *square*, so that no vacant spaces may be left. I began gauging with circular fields, thinking the gaps of no importance, but having tested the results against those obtained with square fields I found the former quite untrustworthy.

Had I used so large a number as nine prisms in any manner in which a spectroscope is ever spoken of in the present day as containing nine prisms,—*i. e.* nine separate pieces of glass, each going on both increasing the dispersion of the previous ones, and decreasing the intensity of the transmitted light by reflection at first and second surfaces of each piece: why, of course, on such originally faint rays as those of the Zodiacal manifestation, there would have been at last at the eyepiece of the instrument so little direct transmitted light, and that so much dispersed, that the result must have been futile.

And so it would have been also with "three or five" such prisms, as stated to have been recommended to me by Mr. Proctor as better than "nine." Quite needlessly too; for I, knowing all that long before, had used only *one* prism of peculiar order, and which I had correctly described in the paper read to the Royal Astronomical Society as a direct "vision prism stick or combination." That *one* such prism was made up indeed of nine pieces of glass, but all of them, in the invariable manner of all direct-vision prisms which I have ever heard of, stuck or cemented together with Canada balsam so as to destroy reflection at the internal surfaces; while one half of the pieces being set so as to decrease the dispersion of the other half, and all of them being of very small angle, the final result was not very different to that of a single ordinary flint prism of 60°, except in the convenience of its application to the phenomenon under examination.

I trust, therefore, you will see, that it was an undeserved libel to say that I used inappropriately so many as *nine* "prisms," and then to undervalue my observations for *that* asserted reason. I may add also, that I have two direct vision prisms very similar in size and shape externally, but consisting internally, the one as above, of nine small angled, cemented pieces, and the other of three of very large angle; and that the former gives both the brighter view and the larger field, with very nearly the same dispersion.

I remain, yours very truly,

15, Royal Terrace, Edinburgh: C. PIAZZI SMYTH.
2nd July, 1872.

PROFESSOR SMYTH'S OBSERVATIONS OF THE ZODIACAL LIGHT.

Sir,—By some mistake a strange inaccuracy has crept into your report of my remarks, respecting the observations made by Professor Smyth on the zodiacal light. The report runs thus: "Mr. Proctor thought the observations rather doubtful, from Professor Smyth having used so many as nine prisms," &c. I expressed a very strong opinion of confidence in Prof Smyth's observations. I said just before concluding, that the only doubtful point seemed to be whether Prof. Smyth could not have obtained even better results had he used a direct-vision prism of five component prisms, or seven, instead of one with nine component prisms. This I suggested on the authority of our chief spectroscopist, to whom I referred by name.

But obviously, the mere fact that Prof. Smyth saw the continuous spectrum, proved that his direct-vision prism did the work it was meant to do.

I used very strong expressions in favour of the paper before summarising the results contained in it.

The first part of the report requires also to be slightly corrected. Liais saw a faint continuous spectrum, not a strong one, and the impressions conveyed by the arrangement of the names of the observers are not quite correct. But the gentleman who reported must not be held in fault, for there was a great pressure of time, and I spoke in five minutes what I had proposed to say and read in twenty.

RICHARD A. PROCTOR.

LOGARITHM TABLES.

Dear Sir,—The paper by Mr. Lee Glaisher on Logarithm-Tables to ten figures in Monthly Notices for this month May 1872, p. 258-62, reminds me of a long cherished idea, viz., of printing only the 6th, 7th, 8th, 9th, 10th decimals of logs of every number from 1 to 108,000 in an 8vo. vol., so as to be an auxiliary supplement at moderate cost to the collections of Hutton, Bremiker, Callet, &c., now in general use.

To these might be appended the 6th to 10th decim. of log. sin. and log. tang. for every ten seconds of space; I should think the whole would not exceed in bulk the ordinary Hutton's logarithm-tables; omitting the hyperb. logs. course and dist., etc., and retaining the useful formulæ of plane and spherical trigonometry.—Ex. Gr. as in—

	0	1	2	3	4	5	6	7	8	9
1000	abcde	fghik	lmnpq	rstuv	abcde 11111			abcde 22222		
1	*abcde*	*fghik*								
2										

If desired, the 6th to 10th places of differences may be printed thus on the opposite page.

0	1			9
fghik—abcde	lmnpq—fghik	*	*	

Also, the useful log. arc.log. sin.; log. tang.—log. arc. for small arcs. The conversion of hyperb. to common logs., and *vice versa* would be much improved by a table of ·001 to ·999 times 2·30258 and ·43429 respectively, taking out *three* figures value at a time, instead of two.

I have much pleasure in forwarding to you this suggestion, as you honoured me with a notice of my paper read before the Society in November last, but which, as on former occasions, the Editor of the *Monthly Notices never even gave the title of;* a voluntary act of suppression which the late Mr. Sheepshanks never exercised towards me or any one else. Thus: *e.g.*, I pointed out in January 'forty-four (M. N. vi. 23) the utility of simultaneous distance-measures of Mars when in opposition from the nearest stars at different terrestrial observatories (*e.g.*, Stockholm and Cape of Good Hope) to obtain the parallax of the sun every ten years, in the stillness of night, with fixed instruments, instead of the seldom, costly, irradiation-affected transits of Venus over the solar disk.

I am, dear sir, yours truly,

74, Offord-road, Barnsbury:
May 29, 1872.

S. M. DRACH.

THE TRAPEZIUM IN THE ORION NEBULA.

Sir,—On page 37 of your last volume, you favoured me by inserting a communication having reference to the above object, and I am now desirous of adding a few words to what has already been said on the subject.

That the small stars in the interior of the Trapezium are variable seems very probable ; some observers have succeeded in detecting the 5th and 6th (in the order of their brilliancy) stars with telescopes of very moderate aperture, while others have, at different times, failed to discern them. Mr. Thomas Owen, of Manchester, writes, in a letter to me that, with an object-glass of 2⅞-inches diameter, he can frequently see *five* stars in the Trapezium very distinctly. In Webb's Cel. Objs., it is stated that the 5th star has been seen with a telescope of 3¼-inches aperture, but only on occasions when the atmosphere has been favourable for the observation of celestial objects. It would appear, therefore, that this star has, of late years, become brighter than formerly, several observers having succeeded in detecting it with instruments of only 3-inch aperture. A few years ago, there was some correspondence on this subject in the columns of the *English Mechanic*, several gentlemen stating that with a 3-inch refractor they had seen the 5th star on several occasions, while an anonymous correspondent disputed this, and was inclined to consider the object quite out of the reach of telescopes of the aperture stated. It would seem, however, that the star has been actually observed with a 3-inch glass, if we are to believe the statements of observers whose testimony would appear to be reliable. If the smaller stars of the Trapezium are variable, they would, of course, be very difficult objects to make out when at their minimum degree of brilliancy, while, on the other hand, they would be much more conspicuous objects when at their brightest ; and, at that time, quite possibly one, if not two, of them could be observed with a 3-inch telescope or even with a smaller instrument. Mr. Owen states, that he can see the 5th *very distinctly* with his 2⅞-inch, and, as he speaks so positively, it is hardly possible that he can be mistaken. In confirmation of the observation to which I have just referred, Mr. R. J. Ryle, of Burton-on-Trent, says that : "On January 6, 1872, while observing the Trapezium in Orion with a 3-in. O. G., p. 80, I was struck with a suspicion of seeing the 6th star. Knowing it requires a larger aperture I should have thought I was decidedly mistaken if I had not received a communication from a friend, at about the same time. saying, he had also suspected he could make out the same star with his *three-inch* telescope." It would be strange, indeed, if both these gentlemen, who are habitual observers, should have been deceived. If not, the 6th star must be very variable ; for it was, according to Mr. Ryle, but very little inferior in brightness to the 5th, and was situated in precisely the same position as that assigned to it. Possibly, then, the 6th star as well as the 5th has been detected with a 3-in. O. G. If this is the case (and there does not appear much reason for doubt) the two stars referred to, must necessarily be variable, otherwise they would not have been considered such difficult objects. At any rate, there appears to be strong evidence in favour of the opinion that they are variable. Mr. John Browning, F.R.A.S, was of this opinion from observations he made in January 1867, and in March of the same year he communicated to the *Register* the results which he obtained. One of the stars (the 5th) which on January 25 was much brighter than another small star seen by him in the Trapezium was scarcely perceptible three days afterwards, and he was quite satisfied that the stars had undergone a change in their brilliancy. From this, he inferred their variability, and this idea is strengthened by the other observations of which I have spoken. Certain it is that, until quite recently, the 5th star was quite out of the reach of a 3-inch O.G., and the 6th being even fainter, was scarcely visible in a telescope under 4 or 4½ inches aperture, while they have now been observed (*and the observation verified*) with a 3-in. and 3½-in. refractor. It is necessary, therefore, in order that we may become better acquainted with the extent and periods of the changes which occur in the amount of light emitted by these minute stars that they should be carefully examined on all favourable occasions. There are very many, indeed, of the readers of your valuable journal, who possess powerful instruments, and if some of them would frequently examine the Trapezium (when favourably situated for observation) their results would, no doubt, be found to be valuable. It does not appear that, during the last few years this most interesting object has been much observed by those who possess telescopes of large aperture. A systematic series of observations of the relative brilliancy of the small stars in this exquisite object (conducted on the same plan as the observations which have recently been made of the lunar crater Plato) would, no doubt, lead to our soon deciding the question as to whether or no they are variable. I hoped to be able to obtain some observations of the Trapezium myself last winter, but did not do so. Perhaps there are some amongst your subscribers who were more successful. If this is the case, perhaps they will send the observations to the *Register* for insertion, for there can be no doubt that the Trapezium in Orion is one of the most interesting objects for telescopic examination.

Believe me, dear Sir, your obedient servant,
WILLIAM F. DENNING,
Hon. Sec. Observing Astronomical Society.

Hollywood Lodge, Cotham Park, Bristol:
June 6, 1872.

NEW DOUBLE STAR, 6 SERPENTIS.

A few evenings since I discovered the existence of a close companion to 6 Serpentis with my 6-inch Alvan Clark refractor. This star is not included in any of the catalogues of double stars I have, and was certainly missed by the Struves. The magnitude of the companion is about the same as the companion to 5 Serpentis (10 of Struve's scale), and the distance I estimate about 3". It is not a difficult object with a six-inch aperture. The place of the star 600,870 is R.A. 15h. 14m. 25s.; N. 1° 11′. I hope astronomers will observe this fine pair, and report results with measurements or otherwise.

S. W. BURNHAM.

Chicago: June 20th.

NEW DOUBLE STARS.

I would ask the attention of observers to the following new double stars found within the last three weeks with a six-inch Alvan Clark refractor. The places are for 1870.

OPHIUCHUS. Weisse xvii, 296, 17h. 17m. 39s.; N 13° 31′. The companion is very small at a distance of about 3″ from the primary *sp*. The principal star is of the 8 magnitude. This is 1m. 36s. preceding Σ 2159, a wide and easy pair (D = 26″, P = 326°).

Libra. Weisse xv, 424, 15h. 24m. 5s. S 12° 33′. This is a quadruple, or double-double star, the two pairs being about the same distance apart as the components of ε Lyræ. The primary is of the eight magnitude, and the companion perhaps 11 magnitude. The other pair is composed of 10 or 11 magnitude stars, the distance of each pair being about 3″.

Bootes. Arg. (+20°) 2904. 13h. 51m, 57s. N 20° 5′. 8.9 magnitude. The companion is very faint, perhaps 14 of Smyth's scale, and distance not much exceeding 5″. It precedes Σ 1797 3m, 50s., and is *sp* Σ 1794, the three forming a triangle. The first pair from Struve is wide and very easy, the distance of the other is 1″.9, but the components being nearly equal, it is not difficult. These pairs are all *nf n* Bootes.

I notice in the *Register* for March a letter from Mr. Holden in reference to the faint stars near ε Lyræ. I found last year a star with a very faint double companion a short distance following. This star is readily found without an equatorial mounting since it is only necessary to place ε^1, the northernmost of the two pairs, in the instrument and wait 1m. 20s. when the star in question will be found in the field. The magnitude of the primary is given by Argelander as 8.8. The companion is composed of two 10 magnitude stars about 2″ apart at a distance of 90″ from the primary. Though perhaps not very interesting as a double star, the duplicity of the companion makes a fair test object for a small aperture, and so far as I know, it has not been noted before. There is a similar but more difficult triple 6m. 15s. exactly *p* ε Lyræ. This star is about 4′.7 south of a 6 magnitude star (B.A.C. 6357) and is easily found. Another excessively faint and moderately close pair will be found 12′ almost exactly north of the triple μ Herculis. The components are of the 11 mag. and about 2″ apart. With my aperture contracted to 3-in. I fail to see the the star at all, but with 3½-in. it is tolerably plain as a single star. This pair is 22s. *p* an 8½m. star, having a distant companion *p*. Perhaps none of the objects named in this paragraph are of sufficient interest to entitle them to be catalogued, but I give them for what they are worth.

I would also call attention to 2 Scorpii and 12 Scorpii. the first a very pretty double, and neither difficult; and particularly to 13 Delphini, 20h. 41m. 22s.; N 5° 32′, a splendid close pair, all discovered with the same glass last year. I looked at the last a few evenings since and compared it with γ Equulei (discovered by Mr. Knott), and found it, but little, if any, more difficult. The distance is but little greater than 1″ and the companion about 10 magnitude. The distance of Mr. Knott's companion to γ Equulei is given in "Celestial Objects" as 2″.2, and perhaps under some circumstances it might be more readily seen. I hope that some of the readers of the *Register* will give these objects attention, and publish observations and measurements if any are made.

In conclusion I may say that the double stars mentioned, and many more found within the last two years, have been referred to all the catalogues I have access to, and are new so far as I have been able to learn. I have Struve's *mensuræ micrometricæ;* Otto Struve's "Catalogue of 514 Double Stars"; Vol. xxxv. Memoirs of the R.A.S. containing Dawe's measurements, and Sir William Herschel's Catalogue, and some works of general character, like Webb's "Celestial Objects." Should any correspondent know of earlier observations of any of these pairs, I should be glad to have the facts stated.

S. W. BURNHAM.

Chicago: June 22nd.

CONNECTION OF METEOROLOGY AND ASTRONOMY.

Sir,—"Another Observer" is only treating us again to his old invention of "Astro-meteorology," as a medium for his profundities. I am no more an admirer of that system than he, and have as little wish to be an advocate of its crudities and imperfections. If, before rushing into print, *he* had been at the laudable pains of making the slightest acquaintance with his subject, he would have known that the well-founded suppositions of some connection between solar disturbances and weather changes, and "planetary conjunctions and oppositions," were no mere platitudes of mine, but have been for years past the opinions of many amongst our best astronomers and physicists. He need even go no further than last January's *Register*. Has "Another Observer" ever heard of the Wanstead Flats ? He would find there a much more fruitful field for cultivation than the "debatable land" between the Goodwin's and Tenterden steeple, where, like Mahomet's coffin, his ideas appear to have been too long hovering.

As to the "nine days" hypothesis, I am not aware of having even hinted at such a thing. I certainly, too, have "casually heard" that there have been other conjunctions and oppositions besides those of last January, to which if he had also referred the barometer curve, he might perhaps have found that in by far the greater number of occasions both the barometric disturbance and the other features of which it is the index, occurred in their intensity on the exact days of such oppositions, &c. Your correspondent is doubless not also aware that there are many occasions of storms, &c., of which the barometer gives no indications whatever, when (to quote the words of Mr. Galton, F.R.S., at the B.A.) "inquiry in respect to ordinary English gales, showed the barometer to be worse than no guide at all!" Now, it is this very deficiency that the union of meteorology and astronomy seems to do away with. Moreover, if his objection to a four days period is of any worth, then of what earthly use is there in our expending 10,000*l*. per annum in building up a system of averages of *five*-day periods and areas of hundreds of miles, through and over which a ship might go nine times out of ten without meeting the average condition at all, or, as in the case of the Telegraph Expedition of 1858, might be nearly storm-foundered in a period and area *where such a storm was shown by these very five-day averages to be impossible of occurrence!*

Now, it is this very uncertainty and defect which the assistance of astronomy supersedes. In regard to oppositions and conjunctions there is no more notable instance of their action and reality than the great storm of November 27, 1703. Speaking of the influence of planetary attraction upon the sun's envelope (*Belgravia* November, 1868, p. 120), Mr. Pattison, C.E., alluded to the probable great crisis which it would undergo should all the planets ever become situated on one side of it (*i.e.* in conjunction). Now, it is remarkable that something of this sort took place on the above date in 1703, when the planets were in the following positions :

♃——⊕ ☽——♀——☉— ☿——♂

Six of the planets were thus in a direct line, and upon such an occasion, if there be any reality in the connection of conjunctions and oppositions, with the disturbances in our own atmosphere, we are bound to expect most remarkable meteorological phenomena. History does not record the grand appearances upon the sun's surface, but the records of the time tell us that on the *exact day* of the completion of this great group of conjunctions and oppositions, the most frightful storm ever remembered before (or since) swept France and England. "It was not," say contemporary chronicles, "as usually happens, a short and sudden burst of tempest, lasting for a few hours, but a fierce and tremendous hurricane of a week's duration, which attained its utmost violence on November 27. The affrighted inhabitants took refuge in their cellars, and many thought that the end of the world had arrived."

We see from the foregoing that the storm began about the time that the earth was approaching the forming line of planets, that it increased as that line became more complete, and attained its intensity on Nov. 27, the *exact day* when the planets made their nearest approach to a direct line with the earth. If they knew as much then as we do now, they might (in spite of the "what earthly use" of "Another Observer") have prepared in some way for the probable visitation, and thus averted some of the disasters at least which ensued. As it was, our bill of damages comprised 800 houses, 400 windmills, 250,000 timber trees blown down, 100 churches unroofed, 300 sail lost on the coast, 900 small craft in the Thames, 1500 sheep, besides cattle, drowned by the overflowing of the Severn. The loss in London was over a million sterling, and Sir Cloudesly Shovel with his fleet in the Downs, lost three ships of 70 guns, one of 64, two of 56, and one of 46 guns, besides 1,500 men, amongst whom was Rear-admiral Beaumont, who perished with others on the *Goodwin Sands*. Winstanley, the builder of the first Eddystone lighthouse, was so well assured of his building, after it had braved the storms of four winters, that he declared "he would like to be in it during the greatest storm that ever blew under heaven!" The wish was fulfilled, as he was in it on November 27, 1703, when the whole structure was blown into the ocean, with its builder and five men.

Fortunately such astronomical conjunctions and oppositions are rare, but, as said by "Another Observer," there are others of a lesser character besides those of last January. Few of them would be found but what would present meteorological extremes of a corresponding ratio of destructive intensity. Those of January were chiefly remarkable for occurring in pairs, the two oppositions of Jupiter and Uranus occurring within four days, an event which, if my memory serves me, is sufficiently rare to account for the rare phenomenon which followed it.

As I stated in my first letter, I do not bring forward these facts as being *conclusive* upon any point; we are yet only on the threshold of inquiry, but I deem the suggestion of Colonel Strange a step in the right direction, as leading to an ultimate appreciation of the connection which exists between astronomy and meteorology.

I read with very much pleasure the letter of Mr. Elvins on this subject. As he has stated (Toronto *Daily Telegraph*, Oct. 24, 1870) that "efforts to foretell the weather by the moon's age, the planets' positions, &c., have resulted in failure, * * let us see if a better fate will await us when we appeal to the sun," I should have liked to have tested the question with him, but must forbear till another opportunity.

Yours respectfully,

July 12, 1872. OBSERVER.

NAKED-EYE OBSERVATIONS OF MERCURY.

Sir,—Referring to a letter by Mr. Lawton in this month's *Register*, in which he speaks of only seeing Mercury once last spring, I believe the planet may be more often caught with the naked eye than is generally supposed, especially if one will look out for the morning as well as the evening apparitions. I have never seen Mercury in the mornings, but have been able several times to detect him with the naked eye after sunset—three times in April, 1858, three times in March, 1860, three times in February, 1862, once in April, 1865, once in February, 1868, once in April, 1871, and twice last spring. The observations of February, 1868, was on the 19th, not the 15th, about which Mr. Lawton speaks, though I find from my note-book that the 15th was a very fine night with us in Lancashire. In the *Register* for March, 1868, page 74, it is mentioned that Mercury was magnificently visible on the 15th, in the neighbourhood of London, and below that is a remark from Mr. Walker, of Teignmouth, about its brilliance on the 19th. Dr. Dick in his "Celestial Scenery" speaks of seeing Mercury with the naked eye three or four times. In Humbolt's "Cosmos," there occurs the following passage about the planet, "If we remember how much, from the earliest times, the Egyptians were occupied with the planet Mercury (Set-Horus), and the Indians with their Budha, how under the clear sky of western Arabia the star-worship of the tribe of the Asedites was directed exclusively to Mercury, and that Ptolemy, in the 9th book of the 'Almagest,' was even able to avail himself of fourteen observations of that planet, extending back to 261 years before our era, and belonging in part to the Chaldeans, we shall be surprised that Copernicus, who lived to attain his seventieth year, should have had to complain on his death-bed, that, much as he had tried, he had never seen Mercury. Nevertheless, the Greeks designated this planet, and justly so, "the strongly sparkling" (στιλβων) on account of its occasional intense light. Referring to a communication from Mr. Elvins in this month's *Register*, on a different subject, I do not think I can bear out his supposition of 1871 being a cloudy year, as I find from my note-book that it contained a far larger number of clear nights than any year since 1858, with the single exception of 1870.

Upton Helions Rectory, Yours truly,
Crediton: July 2. S. J. JOHNSON.

MERCURY.

Sir,—Permit me to refer Mr. Lawton to the footnote on page 42 of the second edition of Webb's admirable "Celestial objects for common telescopes;" as also to page 106 of vol. 2 of the *Astronomical Register*, for a notice of an observation of my own on Mercury, made on April 19th, 1864, with my 4·2 inch Ross equatorial. I enclose a fac-simile tracing of the original sketch, taken *ad naturam*, at the time, in my observatory book,

And have the honour to be, Sir,
Your obedient servant,
WILLIAM NOBLE.

Forest Lodge, Maresfield, Sussex.
July 15th, 1872.

REPLIES TO QUERIES.

Dear Sir,—I send the following remarks in reply to the letter of "A Subscriber," in the July *Register*.

The total solar eclipse visible in England next preceding the one of May 3, 1715, occurred, according to Ricciolus's Catalogue of Eclipses, which is contained in Ferguson's *Astronomy* (1772), on July 12, 1684. In addition to this eclipse, there were two others visible between 1715 and "the black Saturday of 1433." These took place on April 6, 1540 and on October 3, 1633.

In regard to the second query of "A Subscriber," I may say that a "3-in. achromatic *is* sufficient to show indications of the markings on Mars about the time of an opposition." Mr. Charles Grover has succeeded in detecting and delineating the general markings on the planet (see *Register*, April 1867, p. 91) with a refractor of only two inches aperture. Mr. John Joynson was also enabled to make (at the opposition of Mars in 1862) no less than 92 drawings of the markings, although he employed a telescope of only 3½ inches. With an O.G. of 3 inches aperture, it would be perhaps impossible to see the precise form of the markings, but no doubt a tolerably good view of their general appearance may be obtained.

I am, dear sir,
Your obedient servant,
WILLIAM F. DENNING.

Hollywood Lodge, Cotham Park,
Bristol: July, 1872.

QUERY—JUPITER.

Is there any evidence of the planet Jupiter giving out more light than he can have received from the Sun?

I. G.

SUN.

Greenwich, Noon. 1872.	Heliographical western longitude of the centre of the sun's disc.		Heliographical latitude of the centre of the sun's disc.	Angle of position of the sun's axis.
Aug. 1	195°·35	+213 δ ξ	+5°·97	11°·30
2	208·59		6·04	11·70
3	221·83		6·11	12·09
4	235·07		+6·17	12·48
5	248·31		6·23	12·86
6	261·54		6·29	13·24
7	274·78		6·35	13·62
8	288·02	+220 δ ξ	6·41	13·99
9	301·25		6·47	14·36
10	314·49		6·52	14·72
11	327·72		+6·57	15·08
12	340·96		6·62	15·44
13	354·19		6·67	15·79
14	7·43		6·72	16·13
15	20·66		6·76	16·47
16	33·89		6·81	16·81
17	47·12		6·85	17·14
18	63·56	+230 δ ξ	+6·89	17·47
19	73·59		6·92	17·79
20	86·82		6·96	18·10
21	100·05		6·99	18·42
22	113·27		7·02	18·72

23	...	126·50		... 7·05	... 19·03
24	...	139·73		... 7·08	... 19·32
—					
25	...	152·96		... +7·11	... 19·61
26	...	166·19		... 7·13	... 19·90
27	...	179·41		... 7·15	... 20·18
28	...	192·64	+240 δ ξ	... 7·17	... 20·45
29	...	205·87		... 7·19	... 20·72
30	...	219·09		... 7·20	... 20·99
31	...	232·31	+243 δ ξ	... 7·21	... 21·25

Assumed daily rate of rotation, 14°·20 + δ ξ.

MOON.

	Libration.		Sun's Place.		Terminator.		
	Selenographical colong. and lat. of the point on the moon's surface which has the *Earth's* centre in the zenith.		*Sun's* centre in the zenith.		Selenographical colong. of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets.		
Greenwich, Midnight.					Sunrise.		
	colong.	lat.	colong.	lat.	60° N.	0°	60° S.
1872.	°	°	°	°	°	°	°
					Sunrise.		
Aug. 9	96·55	—4·99	339·70	+1·41	72·2	69·7	67·2
10	96·90	—3·90	351·93	1·43	84·4	81·9	79·4
—							
11	96·97	—2·59	4·15	1·44	96·7	94·1	91·6
12	96·70	—1·10	16·36	1·45	108·9	106·4	103·8
13	96·05	+0·50	28·57	1·47	121·1	118·6	116·0
14	94·98	2·10	40·76	1·48	133·3	130·8	128·2
15	93·53	3·62	52·95	1·49	145·5	143·0	140·4
16	91·74	4·91	65·14	1·50	157·7	155·1	152·6
17	89·73	5·88	77·32	1·51	169·9	167·3	164·7
—							
18	87·69	6·43	89·50	1·51	Sunset.		
19	85·79	6·54	101·68	1·52	9·1	11·7	14·3
20	84·21	6·20	113·86	1·52	21·2	23·9	26·5
21	83·07	5·48	126·05	1·53	33·4	36·0	38·7
22	82·43	4·46	138·24	1·53	45·6	48·2	50·9
23	82·30	3·22	150·43	1·53	57·8	60·4	63·1
24	82·64	1·86	162·63	1·53	70·0	72·6	75·3
—							
25	83·36	+0·45	174·84	1·53	82·2	84·3	87·5
26	84·38	—0·95	187·06	1·53	94·4	87·1	99·7
27	85·60	—2·29	199·28	1·53	106·6	109·3	111·9
28	86·94	—3·50	211·50	1·53	118·8	121·5	125·2
29	88·31	—4·57	223 72	+1·53	131·1	133·7	136·4

Query : Which point or spot near the middle of the moon's disc is practically the best adapted for serving as a fundamental mark in selenographical investigations ?

The best determined point on the moon's surface is the centre of the crater Moesting A (in lat. 3° 11′ and long. 5° 13′, or colong. 95° 13)′, which has been used as the mark of reference in the Kœnigsberg observations for the investigation of the moon's librations. Bessel selected this crater in preference to others, because, as he states (Astron. Nachrichten, vol. 16, p. 276), "it appears, *even* in full moon, very bright, and in sharply defined form, and also because it may, by means of its surroundings, be easily distinguished from other similar craters, so that the observer is not exposed to the risk of mistaking it." Bessel made his selection on March 31, 1839, two nights after full moon, and there is no question that for some days before and after full moon, when the crater is fully lighted up, it makes a very good mark. But it seems very questionable whether nearer the times of first and last quarter, when the interior of the crater is partly shaded, its centre can be correctly estimated without considerable difficulty. Will observers of the moon who have the opportunity please watch and sketch the appearance of this crater under its different illuminations? And will they please try to find a really *better* mark, if it exists? Maedler suggested (Astr. Nachr., vol. 15, p. 12) the crater Triesnecker B, but its variable appearance tells likewise against it.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN AUGUST, 1872.

By W. R. Birt, F.R.A.S., F.M.S.

The lists for May and July, 1871, may be employed for the selection of objects suitable for observation in August, 1872. On p. 150 of the June number of the present volume, the value of supplement ☾ — ☉ on May 21, 1871, is given as 152° 21.′ On August 6, 1872, the value of supplement ☾ — ☉ will be 151° 21.′ In vol. ix., pp. 172, 173, the values on July 20 and 31, 1871, respectively were 142° 24·8′ and 1° 32′·7. In 1872, on August 13, supplement ☾ — ☉ = 1° 50′·4. The two lists are therefore available from August 6 to 18 of the present year.

Eighth Zone of objects from North to South.

Palus Somnii, Guttemberg, Magelhaens, Colombo, Sautbech, Borda, Metius, Fabricius, Janssen,(a) Rosenberger.

The eastern boundary of the preceding seven zones was printed in the last communication as 25° of west longitude. It should have been 45°, which would, according to the suggested admirable alteration, for some purposes be 45° from the western or preceding limb at mean libration. The present zone extends 5° further eastward, *i.e.*, to 40° west longitude, or 50° from the preceding limb at mean libration. The objects will be coming into sunlight on the 7th astronomical reckoning, and may be looked for on the evening of the 8th, when the moon is about four days old. As the autumn approaches the early moon has decreasing altitudes in the western sky, but this disadvantage is compensated by the much greater facilities for observing the objects in the eighth zone under the setting sun during the first four days after full moon, and it is recommended that advantage be taken of the harvest and hunting moons for observing the objects in the eight zones.

It is suggested that particular attention be given to **Gassendi** under *every* illumination, several gentlemen have had it under observation for some months past, and additional observations will be valuable.

(a) See list for September, 1871, vol. ix., p. 217.

ASTRONOMICAL OCCURRENCES FOR AUGUST, 1872.

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn.
Thur	1	 23 36	Sidereal Time at Mean Noon, 8h. 41m. 36·14s. Conjunction of Moon and Mars, 2° 17' S.			— 10 27·4
Fri	2	16 5 23 50	Conjunction of Sun and Jupiter Conjunction of Moon and Uranus, 3° 27' S.			10 23·2
Sat	3	21 45 17 39	● New Moon Conjunction of Moon and Jupiter, 3° 55' S.			10 19·0
Sun	4	7 15	Conjunction of Moon and Venus, 3° 28' S. Saturn's Ring: Major Axis=41"·19 Minor Axis=17"·00			10 14·8
Mon	5		Sun's Meridian Passage, 5m. 41·43s. after Mean Noon			10 10·7
Tues	6	2 10	Conjunction of Moon and Mercury 7° 45' S.			10 6·5
Wed	7					10 2·3
Thur	8					9 58·1
Fri	9					9 53·9
Sat	10	9 43	Near approach of 96 Virginis (6½)			9 49·7
Sun	11	17 52	☽ Moon's First Quarter			9 45·6
Mon	12	9 47	Occultation of λ Libræ (6)			9 41·4
Tues	13					9 37·3
Wed	14					9 33·1
Thur	15	15 50 7 50 8 53	Conjunction of Moon and Saturn 3° 7' N. Occultation of 6 Saggittarii (2½) Reappearance of ditto Illuminated portion of disc of Venus = 0·992 Illuminated portion of disc of Mars = 0·982			9 29·0
Fri	16					9 22·8

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sat	17		Sidereal time at Mean Noon, 9h. 42m. 41·03s.			9 20·7
Sun	18	8 53	○ Full Moon			9 16·5
Mon	19		Sun's Meridian Passage, 3m. 18·78s. after Mean Noon			9 12·4
Tues	20	8 51 9 28 10 8 11 11 13 22	Occultation of 30 Piscium (5) Reappearance of ditto Occultation of 33 Piscium (5) Reappearance of ditto Near approach of B.A.C. 17 (6)			9 8·3
Wed	21	14 5 15 1	Occultation of 26 Ceti (6½) Reappearance of ditto			9 4·2
Thur	22					9 0·1
Fri	23	2 53 12 57	Conjunction of Venus and Mercury, 6° 29′ S. Conjunction of Uranus and Mars 0° 30′ N.			8 56·0
Sat	24		Saturn's Ring: Major Axis=40″·32 Minor Axis=16″·82			8 51·9
Sun	25	8 34	☾ Moon's Last Quarter			8 47·8
Mon	26					8 45·7
Tues	27					8 39·6
Wed	28					8 35·6
Thur	29					8 31·5
Fri	30	7 51 9 12 17 29	Inferior conjunction of Mercury Conjunction of Moon and Uranus 3° 38′ S. Conjunction of Moon and Mars, 3° 18′ S.	3rd Oc. R. 1st Sh. I. 1st Tr. I.	15 36 16 1 16 55	8 27·4
Sat	31	11 41	Conjunction of Moon and Jupiter, 4° 12′ S.			8 23·4
SEPT. *Sun*	1	19 53	Conjunction of Moon and Mercury, 8° 57′ S.			8 19·3

THE PLANETS FOR AUGUST.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	10 32 21	+ 7 56	7″·2	1 50·4
	15th	11 1 28	+ 2 11	9″·2	1 24·4
Venus ...	1st	9 7 22	+17 52	9″·6	0 25·7
	15th	10 15 22	+12 21½	9″·8	0 38·5
Saturn ...	1st	19 10 45	—22 16	16″·6	10 27·4
	15th	19 7 18	—22 23	16″·4	9 29·0

Mercury may be observed at the beginning of the month as an evening star, setting on the 1st about 48 minutes after the sun, the interval decreasing.

Venus is still too close to the sun to be well observed.

Saturn may be fairly observed till after midnight, setting at the beginning of the month two hours and a half after midnight, the interval decreasing at the end of the month to about half an hour.

REVIEW.

Essays on Astronomy. By Richard A. Proctor. Longmans, Green & Co., 1872.

We are glad that Mr. Proctor has determined to publish in a collected form some, if not all, of the many articles and notices which have appeared from his clear and running pen in the various serials and reports of the societies. In the present volume he has gathered together a number of essays upon more strictly scientific subjects, and he promises a second volume of a somewhat lighter kind, and more closely associated with the subject of the plurality of worlds. There are in the present volume three interesting articles upon Sir John Herschel; others on the planets Mars and Saturn (beautifully illustrated); meteors; the zodiacal light; the Sun's corona; coloured suns; Sirius, &c. Some of the more abstruse subjects have been been put into the appendices, among which we may notice an able paper upon the transit of Venus in 1874. Mr. Proctor, in answer to those who profess to object to popular science, and who would imply that, because he has done so much to make science popular, he necessarily has written in a superficial way, says that he has never written anything in the popular serials upon any subject that he had not previously treated more solidly. This is always borne out by the dates of the various essays. We believe that he has done much to incite an interest for these subjects among those, who under ordinary circumstances, would not have dared to encounter the difficulties and labour of learning, and by so doing, we feel sure that he can have done no harm, and that he has really enlisted many valuable hands in the service of science. We shall be happy to hear that the success of this volume induces Mr. Proctor to give us more.

SALE OF A LARGE ACHROMATIC.—The great refractor, by Cooke and Sons, of York, which was shown at the International Exhibition of 1871, was sold by auction by Messrs. Stevens, of King Street, Covent Garden, on the 12th ultimo, for about 750*l.* The instrument, which had every modern appliance, and was one of the most complete ever turned out by these celebrated makers, was of 10 inches clear aperture, and was originally priced at 1,200*l.*, but owing to the rise in wages and materials would now be charged much more. The purchaser was Mr. Henley, the telegraph engineer.

Errata. In list of subscribers for *Seecomber* read *Seccombe*; for *Hubbeosty* read *Hubbersty.*

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June, 1872.
Rivaz, Miss.

To July, 1872.
Ormesher, H.

To Sept., 1872.
Hendry, W.

To Dec., 1872.
Andrews, W.
Crowe, Rev. R.
Glover, E.
Gooch, Miss.
Lance, G. A.
Lewis, R. T.
Locke, W.
Metcalfe, Rev. W. R.
Nelson, E.
Noble, Captain.

To June, 1873.
Gladstone, Murray.

NOTICE.

JOHN BROWNING begs respectfully to inform scientific gentlemen and the public generally, that he has taken the Premises, No. 63, Strand, opposite Bedford Street. These premises he will open as a West-End branch of his business on the 18th of March. In a Show-room on the ground floor there will be every convenience for testing, or seeing in action, Microscopes, Spectroscopes, Astronomical, Electrical, and other Philosophical Apparatus. There are light workshops on the premises. Communication has been established by electric telegraph with the Factory at 111, Minories. JOHN BROWNING, Optical and Physical Instrument Maker to the Royal Society, the Royal Observatories of Greenwich and Edinburgh, &c., &c., &c., 63, Strand, W.C.; 111, Minories, E.; and 6, Vine Street, E.C. Specialities, Spectroscopes, Astronomical Telescopes, Polariscopes, Microscopes, and Electrical Apparatus.

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TO CORRESPONDENTS.

Smyth's Celestial Cycle.—Our Sydney Correspondent, whose exact address we have mislaid, is informed that we can procure a good copy of the above work for him if he still wishes to have it.

Notice.—It is particularly requested that all communications be addressed to the Editor, Parnham House, Pembury Road, Clapton.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

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The Astronomical Register.

No. 117. SEPTEMBER. 1872.

THE BRITISH ASSOCIATION AND LUNAR WORK.

"He that putteth his hand to the plough and looketh back!"—we know the rest. Twenty years ago the British Association for the Advancement of Science put its hand to a work of no small magnitude and of no little importance. Unostentatiously it sought to throw light upon bygone Selenological changes through the instrumentality of accurate *drawings* of portions of the moon's surface; and some delineations of Gassendi, Plato, and the Mare Crisium, were executed by members of the first Lunar Committee. After a repose of eight years a partial revival took place, and a report was presented embodying some observations of the Crater Plato, in the course of which several objects in and around Plato were particularly examined. Four years later the energies of the Association were directed to a much greater work: the compilation of a catalogue of lunar objects accompanied by critical and explanatory notes, and assisted by a grant from its funds. The few following years, 1865 to 1868, witnessed an extension of the work, by the projection of a map on the scale of 200 inches to the moon's diameter, and during the four years four sections or areas of 5° in latitude and longitude were produced. These areas included every object that could be detected with ordinary telescopes, or found on existing photograms. At the meeting of the Association in 1868, objections were made to the great extent of the work and to the necessary slowness of its progress, which it was considered rendered it unsuitable for receiving the assistance of the Association, and, in consequence, the Committee was not reappointed at that meeting. Two years later the Association took up another line of lunar research, viz., the discussion of observations of lunar objects suspected of change, which has been continued for two years. The first year's work has been confined to an examination of the observations of the spots on the floor of Plato, and the second year's work to a similar examination of the observations of the streaks and markings on the floor. We find that the

Committee for carrying on these discussions has not been reappointed, and thus for the fourth time the Association has withdrawn from lunar work.

Of what value is this work which has been taken up in so desultory a manner by the British Association? On reviewing its progress we find in the first instance certain drawings produced, those which were published being three views of the Mare Crisium, by Professor Piazzi Smyth, under the morning, mid-day, and evening illuminations. An interesting series of unpublished drawings of Plato and the Alps are in existence. The labours of the revived Committee, in 1860, were confined to a single report. Much more work appears to have been effected by the Committees of 1864 to 1868. Nearly 500 objects on the four areas included by 10° of south latitude and 10° of west longitude, have been critically examined, and their outlines laid down on the scale above-mentioned. The catalogues of these objects, we are informed in the Report of 1869, contain numerous selenographical and selenological notices, having reference to the sequence of events, such as the protrusion of mountains, the formation of valleys, the appearance of ancient regions containing the remnants of grey plains and mountain ranges, which degrading agencies have so modified as to occasion them to present a very different aspect to that which we find characterising formations of a much more recent period, but still remote in selenological time; in fact, the Committee appear to have treated the subject they had in hand much as geologists have treated geological phenomena. Although a lunar survey of this kind must necessarily be one of great labour, consuming a large amount of time, the fixing of the lunar features to a definite epoch is of such great value in selenographical researches, that it is a matter of regret that it has been discontinued, especially as the amount of the grant never exceeded 120*l.* annually. One important result has grown out of this work, viz., the possibility, if not the probability, of detecting the changes occurring on the moon's surface by which *deep* craters such as Linné, previously described as "very deep," have disappeared as if they had been filled up, has led to a very close inspection of the Crater Plato, which has been the subject of the most unremitting attention for at least two years. The discussion of the observations of Plato is the last work of the Association connected with the moon; it has shown that small spots varying in intensity of brightness and visibility are numerous on the floor, and that the streaks and markings which appear to be intimately connected with the spots, are also variable in form and brightness. The most striking result, however, is the darkening of the floor as the sun attains his greatest altitude above the horizon of Plato. These are certainly results which are leading us on towards a clearer conception of the state of the surface, and must contribute to the formation of views of the operation of forces, modifying that surface, of a character much nearer the truth than those formerly held.

So far as we are able to learn, the Association has withdrawn from this important work on account of its magnitude. The mapping of the surface in the way proposed consuming so large an amount of time, that its completion cannot be expected within any reasonable period, and with regard to the work, not less important, of observing definite portions of the disc, it may be remarked that, in order to detect such changes as the last Committee in its two reports has indicated, it is a work of considerable labour, and much time must be consumed in making the necessary observations. Now, it may be worth while to enquire if reasons such as these ought to weigh in retarding a work that promises to be of great benefit to *future* Selenographers? In the first place, no great work can be proceeded with except it be step by step; each portion must be made good before the next is attempted, and if the aphorism—

> "By many blows that work is done
> Which cannot be achieved by one,"

be kept steadily in view, and the main object not allowed to sleep, progress must result. Had the Association continued its grant, even if reduced to £100 *per annum*, it is more than probable that, by this time, four more areas of the map would have been completed, and a larger number of objects catalogued, and, as regards observations, we have reason to believe that by pursuing a course similar to that adopted by the last lunar Committee, a large number might be obtained capable of yielding important results. If these views be correct, it appears that the proximate effect of the withdrawal of the Association from the work has tended to retard it. Nevertheless, so far as the grants have been judiciously applied, the Association has been true to its designation; it has advanced the science of Selenography. In the second place, because the Association has withdrawn, and the work has been proportionately retarded, are we to come to the conclusion that it will languish and die out? By no means,—languish it may, but if there be energetic and devoted Selenographers, and they are upon the increase, the study of lunar physics will assuredly not die out. Observers will not be content with the works of Schröter, Gruithuisen, Lohrmann, Madler, Smidt, and Bulard, but will seek in some way to bring their own work before the public, to place their observations on record, and to secure an examination and discussion of them, that their labours may not be lost, but that posterity may reap the benefit, should they not meet with a favourable reception at the hands of living astronomers.

HISTORICAL ECLIPSES.

Mr. J. R. Hind, writing from Mr. Bishop's Observatory, Twickenham, furnishes us (*The Times*) with the following interesting sketch of the Eclipses recorded in History:—

"It is well understood that the historical eclipses, especially those of the sun, have an important bearing upon our knowledge of the elements of the moon's motion, as affording the means of testing the accuracy of those elements when carried back to very remote times. I send you a brief account of some results I have deduced in a systematic examination of these eclipses, making only such a selection therefrom as may possibly possess interest for the general reader. I shall omit any reference to the purely astronomical conclusions to which I have been led, which would be out of place in your columns, and, indeed, would extend this communication beyond reasonable limits. It may, however, be desirable to state that I have employed the last value of the secular acceleration of the moon's mean motion given by Professor Hansen, of Gotha, the author of the latest lunar tables, and have combined other important elements as determined by him with the results of M. Leverrier's tables of the sun. From recent investigations, it appears by no means improbable that we may have to rely wholly upon the ancient eclipses in fixing the true amount of acceleration in the motion of our satellite.

"I shall follow the chronological order in the subjoined remarks upon some of the better known eclipses of history. These form a part only of the phenomena I have rigorously examined upon the same system of calculation.

"1. The Nineveh Eclipse of B.C. 763, June 15.—The discovery of the record of this eclipse on one of the Nineveh tablets in the British Museum was announced by Sir Henry Rawlinson in the *Athenæum* of May 18, 1867, to which I refer for details of its bearing on the sacred and profane history of the period. In the actual state of our knowledge it is the *terminus a quo* for researches on the historical eclipses, and I believe I am correct in saying its value in an astronomical point of view is greater than that attaching to the famous eclipse predicted by Thales to the Ionians, as mentioned by Herodotus. The underlining of the inscription appears to indicate a phenomenon of unusual character or that the eclipse was total in or near Nineveh. Adopting for the position of the city the longitude and latitude deduced by the Astronomer-Royal for the pyramid of Nimrud, I find the calculated southern limit of totality would pass a few miles south of Nineveh, leaving a very large partial eclipse at that city. Very trifling corrections in the lunar elements employed would suffice to bring the total eclipse over it. In this longitude the duration of totality on the central line would be 4m. 20s., the middle of the eclipse at half-past 9 local time.

"2. The Eclipse of B.C. 689, January 11.—The idea that the retrogression of the shadow on 'the dial of Ahaz' during the illness of Hezekiah may have been connected with a solar eclipse has given rise to much discussion, and several writers have endeavoured to point out how the occurrence might thus be explained. Of the eclipse to which attention has been directed the above has perhaps appeared the more probable. It was an annular eclipse, and at Jerusalem the sun would present the form of a luminous ring for 7½ minutes, the middle at 10h. 18m. In Babylon it would have the same appearance for seven minutes. It seems hardly probable that the eclipse could have occurred much latter in the day, though more than one author has considered the circumstance essential for the explanation of the retrograde motion of the shadow on the ancient form of sun-dial by an eclipse. I must leave the reader to judge how far the expression "wonder done in the land" may relate to such a phenomenon, which is, of course, a very rare one in a particular locality.

"3. The Eclipse of Thales, B.C. 585, May 28.—This eclipse, which, as Herodotus informs us, terminated the six years' war between the Medes and Lydians under Cyaxares and Alyattes, when during a battle, 'day was suddenly turned into night,' has greatly exercised the chronologist and the astronomer, and although, misled by imperfect tables of the lunar motions, they have fixed upon other eclipses from time to time, it has been known for some years past that the date distinctly assigned by Pliny (the fourth year of the 48th Olympiad) is the correct one. My new calculation throws the shadow precisely over the tract of country where with the greatest probability it has been supposed the contending armies were situated, and in addition it indicates a circumstance which I believe has not resulted from any previous calculation, and which may not be without its chronological import—viz., that the eclipse was total in Nineveh for between three and four minutes shortly before sunset. The date of the final destruction of Nineveh is closely connected with the eclipse of Thales.

"4. The Eclipse of Xerxes, B.C. 473, February 17.—Much difficulty has been experienced by chronologists with an eclipse which occurred, according to Herodotus, in the early spring, when Xerxes was setting out from Sardis on his expedition against Greece. It is certain that there was no such phenomenon in the year B.C. 480, to which this event is usually referred, and in examining the eclipses about this period, I found only one that can apply. There is no doubt that the sun was very largely eclipsed at Sardis on the morning of February 17th, B.C. 478. A direct calculation for this place shows that more than 94-100ths of the sun's diameter would be covered, the greatest phase ten minutes after 11, local time. The eclipse was annular, and Sardis appears to have been just outside the annulus. One other eclipse only was visible in eastern Europe about this year, it occurred B.C. 479, October 2, and has been considered to be the one which occurred at the time Cleombrotus consulted the oracles at Sparta. Its magnitude there is found to have been about 6-10ths, the greatest eclipse at 0h. 50min. If the eclipse of B.C. 478 be truly the one recorded by the historian, the date of the battle of Salamis will require to be brought down two years.

"5. The Eclipse of Agathocles, B.C. 310, August 15 (Diodorus, Justin). On the morning after the fleet of Agathocles sailed from Syracuse for Africa, the historians tell us the sun was eclipsed to such a degree (*tantum fit solis deliquium*) that the stars appeared everywhere as at night. Though Agathocles could hardly have been more than 100 miles from Syracuse, it is uncertain in which direction he had sailed, or whether he was rounding Sicily on the north or south side, and this circumstance detracts from the scientific value of the record. My calculation throws a central line near the African coast, so that the fleet, if sailing southwards, would be near the northern limit of totality.

"6. The Eclipse on the Passage of the Rubicon by Cæsar (Dion), B.C. 51, March 7.—This would appear to have been a very notable phenomenon on the Rubicon and in Northern Italy generally. The eclipse was annular, and the annular phase continued 6min. 30sec. At Rome there would be a partial eclipse, about three-fourths of the sun's diameter being covered. A line drawn from 9 deg. 24 min. E. and 43 deg. 26 min. N. to 14 deg. 39 min. E. and 46 deg. 15 min. N. will define the course of the central eclipse across Italy, and the ring-formed appearance of the sun would extend to about 1 deg. 35 min. north and south of this line. The Rubicon would be placed about midway between the central line and the southern limit. Near Ariminum the middle of the eclipse occurred at 0h. 50m. By some writers (including the Abbè du Fresnoy, in his valuable 'Tablettes Chronologiques,') the eclipse is dated B.C. 50; the above, however, is the correct year.

"A great eclipse has been referred in the year B.C. 43 or 44, soon after the death of Julius Cæsar, and it is instanced by Baron de Zach and M. Arago as the first annular eclipse upon record. Calculation shows that there could not have been an eclipse, annular or otherwise, visible in Italy in either of these years, nor, indeed, for several years before or after. The phenomenon alluded to, was, no doubt, of a meteorological character, and this would appear from the passage in Suetonius, one of the authors quoted upon the subject.

"7. The Eclipse of Herod (Josephus).—The lunar eclipse, which I take to be the one recorded by the Jewish historian during Herod's last illness, occurred B.C. 1, January 9. On this occasion the moon passed nearly centrally through the earth's shadow, entering it at 11h. 23m. p.m. mean time at Jerusalem, and emerging at 2h. 57m. a.m. on the 10th; the total eclipse continued 1h. 39m. This is the date recognised by Calvisius, and recently supported by Mr. Bosanquet. An eclipse in B.C. 4, on the night between March 12-13, which other chronologists have supposed to be the one referred to, was partial only, and did not commence till 1 a.m.; little more than half the moon's diameter was immersed in the earth's shadow at greatest phase.

"8. The Eclipse of Phlegon in the 202d Olympiad (Eusebius), A.D. 29, November 24.—Total on a line crossing the Black Sea, rather west of Odessa, to Sinope, thence, near the site of Nineveh, to the Persian Gulf. At Jerusalem a partial eclipse; about 11.10 a.m. eight-tenths of the sun's diameter would be covered; at Heliopolis (Baalbec) also partial—nine-tenths. At a point on the central line near Sinope the totality would continue 1⅓ minutes. Humboldt mentions that this eclipse had been calculated by Wurm, but I have not met with his results. It is the only solar eclipse that could have been visible in Jerusalem during the period usually fixed for the ministry of Christ.

"The moon was eclipsed on the generally received date of the Crucifixion, A.D. 33, April 3. I find she had emerged from the earth's dark shadow a quarter of an hour before she rose at Jerusalem (6 36 p.m.), but the penumbra continued upon her disc for an hour afterwards.

"9. The Eclipse of 113, May 31.—Kepler, after endeavouring to ascertain the date of a total eclipse mentioned by Plutarch as having 'recently occurred about noon,' when the darkness was like that of night, and stars were seen in all directions, states he had found none which accorded better with the description than the above. On submitting it to calculation on the modern elements, the central line appears to have passed too far north—over central Germany. I have not succeeded in discovering the date of this eclipse, though I have accurately examined several at the close of the first and beginning of the second century.

"10. The Eclipse of 418, July 19.—Very large at Constantinople, according to Philostorgius, who relates that at the eighth hour of the day the sun was so far eclipsed that the stars appeared, and a comet which had not been previously perceived became visible during the obscurity, and was watched for more than four months afterwards. According to my calculation the central line passed somewhat to the south of Constantinople, where ninety-five hundredths of the sun's diameter would be covered. At a very short distance below that point the eclipse would be total. This is the second occasion upon which the discovery of a comet during a total, or nearly total, eclipse of the sun is recorded in history.

"11. The Eclipse of 671, December 7, on the attempted removal of the pulpit of Mahomet from Medina.—Professor Ockley, in his "History of the Saracens," mentions on the authority of several Arabian writers a a large solar eclipse which occurred about the 52nd year of the Hegira. The Caliph Moawiyah having formed the intention of removing the Prophet's pulpit from Medina to his residence at Damascus, his people proceeded to do so, 'when immediately, to their great surprise and astonishment, the sun was eclipsed to that degree that the stars appeared.' Baron de Zach refers the eclipse to 674, October 4, but in this he is certainly mistaken—I believe through a wrong assumption as regards the moon's latitude. The correct date would appear to be 671, December 7. The eclipse of this day was annular on the central line. At Medina the greatest phase occurred at 10h. 43m., when 85-000ths of the sun's diameter would be obscured. In the clear skies of that part of the world such a degree of eclipse might be sufficient to bring out the brighter planets or stars. No larger eclipse, visible at Medina, occurred about this epoch.

"12. The Eclipse of 840, May 5.—Among the causes which are said to have brought on the '*maladie de languer*' that terminated the life of

Louis de Debonnaire was 'the fright which a total eclipse of the sun had occasioned him.' It is related that the King was taken ill at Worms, and having been removed to Ingelheim, near Mayence; he died there on the 20th of June. I find the northern limit of totality in this eclipse passed about 100 miles south of Worms, and on the central line in this longitude the total eclipse continued 5m 25s., an unusually long interval for the latitude of central Europe. The middle occurred at 1.15 p.m., with the sun at an altitude of 57 deg. The phenomenon under such circumstances must have been a very imposing one, and well calculated in those days to inspire alarm.

"I have already described in your columns the track of the total eclipse of 1140, March 20 (William of Malmesbury) across this country, and merely refer to it now to add, that if any one of your readers is aware of its having been recorded as total in London, he might be doing an astronomical service by making the fact generally known.

"13. The Eclipse of 1133, August 2 (Willliam of Malmesbury), a great solar eclipse, considered as foreboding evil to Henry I. of England.—The central line traversed Scotland from Ross to Forfar, and the eclipse was, of course, large in every part of the country. It would be total in Northumberland. In the centre of Forfarshire totality continued 4m. 20s. Berwick-upon-Tweed was about 20 miles within the south limit.

"During the existence of the kingdom of Jerusalem there is mention of an eclipse which would appear to have been total in the city or its immediate neighbourhood, and has been variously dated from the election of Godfrey of Bouillon in 1097. I am inclined to think it must be to the eclipse of August, 1133, that the record applies, though previous or subsequent events may have been mixed up with it by the historian. Continuing the calculation of the track of total eclipse after leaving this island, I find it would enter Palestine near Jaffa, and pass over Jerusalem and Hebron, where the sun would be hidden 4¼ minutes about 3 p.m., and from Nablous on the north to Ascalon on the south the country would be in darkness for nearly the same interval. The magnitude of the eclipse of 1187, September 4, was rather more than 9-10ths at Jerusalem, the central line passing between eight and nine degrees to the north; in the eclipse of 1191, June 23, the magnitude was about 7-10ths.

"14. The Eclipse of 1433, June 7, long remembered in Scotland as 'the black hour.'—It was a remarkable eclipse, the moon being nearly in perigee and the sun not far from apogee. The central line traversed the country in a south-easterly direction, from Ross to Forfar, passing near Inverness and Dundee. Maclaurin mentions that in his time a manuscript account of this eclipse was preserved in the University of Edinburgh, wherein the darkness is said to have come on about 3 p.m., and to have been very profound. By direction calculation for Edinburgh I find the total eclipse commenced at 3h. 3m. and continued 3m. 41s. At Inverness totality continued 4m. 32s. The after-course of this eclipse was north of Frankfort on the Main and Munich, over the Dardanelles, south of Aleppo, and thence nearly parallel to the course of the Euphrates to the north-east border of Arabia. The totality was observed in the Turkish dominions according to Calvisius.

"15. The Eclipse of 1598, February 25.—Maclaurin says the memory of this eclipse was preserved among the people of Scotland, and 'that day they termed Black Saturday.' He adds:—'There is a tradition that some persons in the north lost their way in the time of this eclipse, and perished in the snow'—a statement the probability of which our experience of recent phenomena by no means tends to support. The central eclipse may be described as having passed about five miles south of Stranraer to the Bass Rock, a little south of Edinburgh, or, more precisely over Dalkeith. Totality came on at Edinburgh at 10h. 15m., and continued 1m. 30s. The duration was the same at Douglas, Isle Man. From the rapid motion of the moon in declination the course of the central line was a quickly-ascending one, in latitude on the earth's surface, the total eclipse passing off within the Arctic circle. Kepler must refer to another eclipse which was observed by Jessenius at Torgau on the Elbe, though he gives the above date.

"16. The Eclipse of 1652, April 8, to which reference is also made by Maclaurin as 'still famous among the populace of Scotland, and known among them by the appellation of Mirk Monday.' The central line passed over the south-east of Ireland, near Wexford and Wicklow, arrived on the shores of Scotland near Burrow Head, Wigtonshire, and running within a few miles from Edinburgh, Montrose, and Aberdeen, left the island at Peterhead. Greenock and Elgin would be situate near the north limit, and the Cheviots and Berwick upon the south limit of totality. The eclipse was observed at Carrickfergus, Ireland, by Dr. Wyberd. I find by direct calculation for this place that it was only just within the north limit of totality, which would commence at 10h. 8m. 30s., and continue 44s. This short duration may partly explain a curious remark of Dr. Wyberd, that when the sun was reduced to 'a very slender crescent of light, the moon all at once threw herself within the margin of the solar disc with such agility that she seemed to revolve like an upper millstone, affording a pleasant spectacle of rotatory motion.' Wyberd's further description clearly applies to the corona.

"I believe it has been generally supposed that the last total eclipse of the sun visible in England was that of 1715, May 3, so wel recorded by Hally in the 'Philosophical Transactions' of the Royal Society, and I was under this impression myself until, on calculating the elements of the eclipse of 1724 (May 22), observed at Paris, and by the French King at the Trianon, I discovered that before reaching France the belt of totality must have traversed the south-west of England, and it now appears that the totality did not pass by us unrecorded.

"I am indebted to the Astronomer Royal for referring me to an account by Dr. Stukeley, who observed the eclipse from Salisbury Plain. The duration of totality in that locality would be rather less than three minutes. The eclipse of 1724 is therefore the last that has been total in England, and as I have shown in a previous communication, there will be no other till August 11, 1999, and that will be confined to the south-west corner of the country."

To this the following reply appeared:

To the Editor of the *Times*.

Sir,—I should be glad to offer a few remarks on the very interesting communication of Mr. Hind on historical eclipses. I will endeavour to be as brief as the importance of the subject will permit.

In regard to events in history it is desirable to lay down some rule as to the respective provinces of historical testimony and science.

In regard to the time, the magnitude, and other circumstances of an eclipse, we must bow at once to the authority of men like Sir G. Airy and Mr. Hind. Dr. Hincks, indeed, asserts that in the mathematical expression on which their calculations are founded there are some coefficients which admit of variation when the calculation relates to very distant epochs. But I do not presume to attribute any weight to this, as I am unable to test it. I accept the determination of all these points as calculated by these great astronomers. But there I feel their absolute authority ends. Their testimony is only one part of the case, and the other evidence must be examined.

In two cases I entirely demur to the conclusions drawn from the evidence of eclipses by Mr. Hind in his valuable Memoir.

These are (1) the eclipse of Thales, and (2) the eclipse of Xerxes.

1. The eclipse of Thales, May 28, B.C. 585. Both Sir G. Airy and Mr. Hind consider that this was the eclipse which terminated the war between the Medes and the Lydians. Now, Herodotus, who was born more than a century after this eclipse, is the original authority on which the connexion between this eclipse and Thales and the Lydo-Median war has descended to us. But Herodotus declares it to have occurred in the reign of Cyaxares, who died in B.C. 594, as all historical evidence and the authority of Herodotus himself leads us to believe. The question is largely discussed in *Clinton, F.H.*, vol. 1, p. 418. It may be added, however, that some ancient authorities state that it was in the reign of Astyages, the successor of Cyaxares. But, as Clinton shows, many circumstances concur in leading to the belief that this war terminated before B.C. 600. Able astronomers have fixed on two eclipses—B.C. 610 and B.C. 603, as the eclipse of the battle. Thales is said to have predicted the eclipse which closed the war. Some authorities would bring down the reign of Cyaxares beyond B.C. 585, by which they subvert all the most careful chronology, which is established on very strong evidence. But this is surely unphilosophical. A tradition first reported 120 years at least after the event connects the close of the war and the prediction of the eclipse by Thales with each other. Another later tradition connects the prediction of the eclipse with the eclipse of B.C. 585. The authority of Herodotus is explicit against a war between the Lydians and the Medes at so late a period. Therefore, if we connect the battle and the eclipse of B.C. 585 he entirely contradicts himself. Does not this teach us to examine the evidence on which these events are connected? A tradition passing through 120 years and many months, might easily be confused. Suppose the eclipse of B.C. 603 to have been the battle eclipse, and Thales, by the *Saros*,* to have predicted that of B.C. 585, is it not easy to see how this tradition might have arisen, and the two eclipses become confused? The answer usually given to this suggestion is, that only a total eclipse could produce so great a moral effect, and that Herodotus says "day suddenly became night." He says the same thing of another eclipse which was not total, except the word "suddenly." But there he adds, "the sun left the heavens." Surely there is not evidence enough in this tradition to overturn all established chronology, which is contradicted also by the author who reports it. We know little what the moral effect of a large eclipse might be in those ages.

2. The eclipse of Xerxes. Mr. Hind appears disposed to bring down the date of the battle of Salamis two years, on the evidence of an eclipse seen by Xerxes on his way from Sardis to Greece. There was no eclipse in B.C. 480, but a large one in B.C. 478. But there was also an eclipse in B.C. 482, and if we suppose him on his way from Susa to Sardis this might be the eclipse. His Magi predicted from it his conquest of Greece.

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* *Saros.* This is the period of 223 lunations, for 18 years, 10 days, and 8 hours, by which the Babylonians calculated eclipses by their observations.

So that it could not be after his defeat; and the date of the battle of Salamis is too well known to admit of a reduction of two years. We must, therefore, believe that there is some error in the tradition, if we deny that any eclipse but that of B.C. 478 is to be accepted. It will be seen at once that a contemporary report of an eclipse stands on a very different footing from a tradition reported half a century afterwards.

These considerations are very important in regard to the evidence on which we accept accounts of historical events. Eclipses are very useful correctives when we can depend on their connexion with the events with which they are associated by tradition; but when that tradition is of a doubtful kind they must be subjected to the laws of historical evidence, as well as of scientific accuracy.

I remain, Sir, yours, &c., IGNOTUS.

THE METEOR COMET OF AUGUST.

To the Editor of the *Times*.

Sir,—The remarkable discovery made in 1866 by Signor Schiaparelli, director of the Observatory of Milan, that the August meteors move round the sun in an orbit almost identical with that of a large comet which became visible in July, 1862, has given occasion to several sensational announcements founded upon the close approach of the comet to the earth's orbit, at the point where it passes from the north to the south side of the plane of the ecliptic, at which point the earth arrives about the 10th of August, when for many years past (indeed, since Professor Quetelet's announcement of the periodicity to the Belgian Academy of Sciences in 1836) we have been accustomed to look for an unusual display of shooting stars. A few remarks may not be inopportune at the present time.

The second comet of 1862, as it is usually termed, was first detected by Mr. Tuttle, now of the United States Navy, at the Observatory of Harvard College, Massachusetts, on the 18th of July, in the constellation Camelopardus, and was subsequently independently discovered at Florence, Rome, and Copenhagen. It presented a very conspicuous appearance in Corona Borealis and vicinity in the latter part of August, exhibiting a tail variously estimated, according to clearness of atmosphere, at from 25° to 30° in length. It was last seen in Europe, at Athens, on the 26th of September; but was followed at the Royal Observatory, Cape of Good Hope, till the 25th of October, when it was lost to view in the southern constellation Ara. A few weeks after the discovery of the comet it became evident that its path deviated sensibly from a parobola, the curve in which, for facility of computation, it is usual to suppose these bodies to be moving, and many comets show no appreciable deviation from this curve, even during a long period of visibility. Various elliptic orbits were assigned, but the last and most complete determination of the elements is by Professor Oppolzer, of Vienna, one of the most accomplished calculators of the present day. He finds the period of revolution to be 121¼ years, and it is certain that this period must be very close upon the true one.

Now, it follows from Professor Oppolzer's definitive calculation of the elements, that in 1862 the orbit of the comet intersected the plane of the earth's annual path at a point which was situate only 430,000 miles from our track—a circumstance sufficient, under certain conditions, to have brought about a collision (so to call it) between the two bodies. In order, however, that this should be possible, the comet must have arrived at its least distance from the sun soon after midnight on the 21st of July, and in this case it would have encountered the earth about noon on August 10th. As it happened, the point of least distance from the sun was not attained till the 23rd of August, and when the comet was upon our track we were far in advance upon our annual journey, and so escaped a meeting which astronomers would probably have regarded with more interest than alarm. It is, of course, possible that at some past time a much closer approach may have occurred, but after carefully examining the various descriptions of comets, European and Chinese, which have descended to us, I have failed to discover any one that can be certainly identified with that of 1862.

If we take the orbit of the comet to represent that of the meteors, we have the following numbers, which will serve for the delineation of their track round the sun.

	Units.
Semi-axis major	24·531
Semi-axis minor	6·805
Semi-parameter	1·888
Perihelion distance	0·963
Aphelion distance	48·100

The above are expressed in units of the earth's mean distance. At least distance from the sun the meteors travel with a velocity of 1,560 miles per minute, and at their greater distance, about 31 miles in the same interval.

From the regular appearance of shooting stars in considerable numbers about August 10th, it would follow that they must be distributed through a large portion of their orbit, though the comet is visible to us only once in about 120 years. Its next appearance, even allowing for the effects of perturbations, can hardly be expected before the year 1980.

The earth will arrive at the comet's descending node about 11 p.m. on Friday next, the 9th inst., and perhaps we may look for the greatest number of meteors during that night, though our passage through the stream usually extends over several days. The comet itself will be distant from us nearly twenty-three times the distance of the earth from the sun, and could we reach it with our telescopes, it would be found in about Right Ascension 9h. 4min. and 27° south of the celestial equator, consequently, in the southern constellation, Antlia Pneumatica. It is only when the comet arrives at its least distance from the sun, between July and September, that it can be a conspicuous object in the northern hemisphere. If this point be reached in winter, it might very easily pass by unobserved, and to this circumstance is no doubt partly attributable the apparent absence of any previous record of its visits to these parts of space.

The radiant point of the August meteors is in about Right Ascension 3h. 24m. and North Declination 52° for 1872, and, therefore, in the neighbourhood of the star Alpha Persei. The apparent radiation from this constellation has led to the frequent adoption of the term "Perseides" for these transient visitors. It is still desirable to fix this point carefully by observation, as during the last few years a somewhat higher declination has been indicated than formerly.

I am, sir, your obedient servant,
J. R. HIND.

Mr. Bishop's Observatory, Twickenham:
August 7.

Present of Newton's Manuscripts to Cambridge University.—A letter from his Grace the Chancellor of Cambridge University has been received, stating that it is the intenton of Lord Portsmouth to present to the university all Sir Isaac Newton's manuscripts, with the exception of those relating to private affairs, and that his lordship wishes the transfer should be proceeded with at as early a period as possible.

Sun Storm.—All our thunderstorms, eruptions, &c., dwindle into insignificance, when we hear of the gorgeous phenomenon which the Rev. Father Secchi, at Rome, a most enlightened clerical, was allowed to observe on our sun's rim a few days ago. It was one of those rugged erosions of the sun's disc, not perceptible to the naked eye, called mildly "rosy protuberances" by the faculty, which in reality are nothing but huge explosions, darting immense quantities of caloric into the planetary space, and thus determining the abnormal temperatures we have sometimes to suffer under or profit by. The eruption lasted for about two hours in the afternoon; spiral flashes of ignited hydrogen, containing volatilised iron, copper, and other metals, took place in unabated fury. The eruption comprised about ten degrees of the sun's periphery, and rose to the tremendous height of 80,000 miles (ten times the diameter of our conceited globe). It then collapsed, but just before the sunset recommenced with double rage.—*Standard.*

The late Sir J. Herschel.—A few days since a meeting, called by Lieutenant-Colonel Loyd, of Lillesden, was held for the purpose of considering a proposal to erect in the parish church of Hawkhurst, in Kent, a window to the memory of Sir John Herschel. Colonel Loyd has procured a design from Messrs. Clayton and Bell, as well as an estimate of the cost. The subject of the window is to be, the wise men of the east following the guiding star to the place of the Nativity, and the cost will be 160*l*. The appeal has been liberally responded to, and a larger amount than is required for the purchase of the window has been subscribed. The memorial will be completed, it is said, by Christmas.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE TRAPEZIUM IN THE ORION NEBULA.

Sir,—There is little evidence in favour of the view that the 5th and 6th stars are variable. As to either being visible with a 3-inch telescope it is somewhat remarkable that the possessors of large instruments can never see them with so small an aperture, although a reduced aperture must be—from the longer focus—at least as good for this purpose as the full area of a small aperture. Careful observers will have noticed the frequent tendency of the rings on some nights to break up into *quasi comites*, and this is a likely cause for the objective appearance which has led persons to believe 3 inches of aperture have exhibited these minute points.

It would seem almost a physical impossibility that a power of 80 with this aperture would suffice to show the 6th, whose distance from the *brightest* of the trapezium was put by Dawes at 2″8.

Mr. Denning has made a slight miscopy on p. 191 (unless it is the typographer), where he gives 3¼ inches as the size mentioned in "Celestial Objects." It should be 3$\frac{8}{10}$ inches—a material difference—which showed the 5th.

I have frequently looked at this beautiful object, but could never see the 5th with a less reduced aperture than would be about equal to a 4-inch refractor.

I believe the only certain method of establishing either the fact or the period of variability is to observe with reduced apertures of instruments fully competent to deal with these minute points on fine nights. They are peculiarly sensitive to atmospheric hindrances.

I am, sir, yours truly,
August 6, 1872. T. H. BUFFHAM.

Sir,—Although I am not prepared to express a definite opinion on the allegation that the 5th and 6th stars are variable, I do with some confidence assert that neither were visible in a 3-inch achromatic between 1861 and 1865. I repeatedly examined the object in question during that period with a good 3-inch of Cooke's, and never could obtain a glimpse even of the 5th star, much less of the 6th. If either is now visible in a telescope of that size, especially if the 6th is visible, they must both of them, but especially the 6th, be variable.

From a perusal of the letters of many observers concerning the brightness of different sidereal objects, I have often come to the conclusion that sufficient caution is frequently not exercised by observers in recording on paper what they have seen; that is to say, that atmospheric influences often affect in a most material degree the visibility of particular objects. In other words, that the fact that A at one time saw a thing which B some time afterwards did not see, is in certain cases rather a proof that B looked through an atmosphere less clear than A did, than that the intrinsic brilliancy of the object under consideration had fallen off, as B would have the world believe.

Windyhills Observatory, Your obedient servant,
Bickdy: Aug. 9, 1872. G. F. CHAMBERS.

Sir,—As in the *Astronomical Register* of this month there is a letter of Mr. Denning upon the visibility in small instruments of the 5th and 6th stars of the trapezium of Orion, it may, perhaps, not be without interest to lay before your readers a translation of an extract from a letter relating to those stars, addressed by M. Wilhelm Temple to the Editor of the *Astronomische Nachrichten*, and inserted in No. 1898 of that periodical, which came to hand a day or two since.

M. Tempel, who writes from Milan on the 8th ultimo, says as follows :—

"I do not know whether the whole of the 6 stars of the trapezium in the great nebula of Orion have been made out with a refractor of 4 inches aperture.

"After having for several years endeavoured in vain to get a sight of the 2 smaller stars of the trapezium, I this spring succeeded in doing so with ease, and that altogether by accident.

"While my having done this is a proof of the excellence of my 4-inch instrument by *Steinheil*, the circumstances under which the observations were made, namely, during the short interval between the end of twilight and the beginning of night, contributed very materially to the result. For earlier in the evening the glare of the twilight prevents the transmission of the more feeble rays, while somewhat later they become overpowered by the brighter stars in the immediate neighbourhood.

"For many evenings in succession I saw without difficulty the stars in question at the period I have mentioned. The 5th star was to be seen with remarkable ease. In *Liapounov's* drawing, Plate 3, its position is not indicated correctly, more so however in Plate 2. The 6th star is somewhat more difficult to make out, inasmuch as it is more minute, and near the brightest star *a* of the trapezium. The power I used was 240.

"On this occasion I moreover noticed, what I never observed before, that the entire trapezium is situated in a delicate but very distinctly visible nebula, which ceases, however, to be distinguishable when the night has grown dark.

"By turning the circumstance above spoken of to account, the companion of Sirius, which many observers have failed to get a sight of, may be perhaps rendered visible in instruments of moderate size."

I am, Sir, your obedient servant,

Lower Norwood. W. G. LETTSOM.

7th August, 1872.

THE NEBULA IN THE PLEIADES.

Sir,—The note on this subject in your last issue is very unsatisfactory, for two reasons,—1st, it contains but a very imperfect statement of previous observations; and, 2nd, the writer totally fails to understand the true meaning of the concluding sentences of my last communication. This renders it necessary to give a fuller statement of the reasons I have had for doubting any change in this curious and interesting object.

1st. The nebula was discovered by Temple, at Venice, October 19th, 1859; he describes it as large, bright, and twinkling in places like a comet; in the next year, 1860, he could just see it in the 6-foot refractor at Marseilles. But it was an easy object to Anwers, of Gottingen, in a comet-finder of 2-feet focus on September 23rd and 24th of this same year, and this when only 16° above the horizon. 1862, August, it was looked for in vain by d'Arrest, of Copenhagen, with an 11-inch achromatic. But on March 26th of this year, Schmidt, of Athens, says, "The great triangular nebula in the Pleiades easily visible, its extension towards the west is, however, much greater than I had previously believed."

In March and September, 1862, it was observed in some of the smaller instruments at Poulkowa; yet the Director, Otto Struve, employing a power of 150 on the achromatic of 14¾ aperture, could only satisfy himself that he saw it by moving the telescope to and fro.

The Rev. T. W. Webb found it readily with a 5½-inch achromatic, 1863, October 6th, but describes it as "very feeble," 1865, September 25th.

2nd. Your correspondent lays particular stress on the fact that the nebula was described as "large and bright" in 1859, while I can now only just see it with a 12¼ speculum. I would call his attention to the observations of Struve, as showing that ten years ago it appears to have been no better seen in the great achromatic at Poulkowa than it is at present in the silvered glass reflector, a similar power being used in both instances.

Your correspondent does not see how the observations of a nebula for 2½ years should make us confident of its condition "many hundreds and perhaps thousands of years ago" But if he carefully reads my letter, he will fail to find where this is stated, or even implied; of course I had read the previous history of this object long before I ever saw the nebula, and I thought the evidence was certainly not in favour of variation; but I refrained from occupying the space of the *Register* by repeating what might easily have been found elsewhere, until compelled to do so; and it was only when I saw the announcement that the object had been searched for in vain with an 8-inch achromatic, followed by the startling assertion, "there is something peculiar about *all* the brighter stars of this group, which for months past have appeared to me as if surrounded by nebulous lights." Can the nebula have been distributed among them? I felt bound to mention the fact that for 2½ years I had observed the nebula unchanged; but, so far from relying on my own observations, I distinctly say, "here then we have an explanation of many of the supposed changes which this object has been supposed to undergo," referring, of course, to the great differences in the visibility of the nebula in different telescopes, and with various magnifying powers, seconded by other observers and witnessed by myself, and then, bearing all this in mind, I conclude in these words, "and it appears more than ever certain to my mind, bearing in view the extreme tenuity and extent of this object, that we see it now exactly as it has existed for many hundreds and, perhaps, thousands of years;" and I fail to see in your correspondent's letter anything calculated to alter this opinion.

Richmond : I am sir, yours very truly,
August 12, 1872. CHARLES GROVER.

HISTORICAL ECLIPSES.

Sir,—In the *Register* for August, Mr. Denning, in replying to "A Subscriber," states upon the authority of Ferguson, that the solar eclipses of April 6th, 1540, Oct. 3rd, 1633, and July 12th, 1684, were visible as total eclipses in England. They are certainly set down in Ricciolus's catalogue as total, but I see nothing in Brewster's edition of "Ferguson's Astronomy," 1821, to show that in any of these cases the total phase was visible in England.

Again, it appears to be assumed that the dark shadow of the moon in the great eclipse of the 17th June, 1433, passed over England instead of Scotland. A very rough computation enables me to say that the central line of this eclipse did not touch England at all, but that a strip of the northern counties was probably within the southern limit of the total phase.

Did this eclipse occur on a Saturday, as was stated by "A Subscriber," or was Wednesday the day?

Will some one of your readers, possessed of the requisite energy, be so good as to compute from the Tables of Leverrier and Hansen, the elements of this eclipse and publish them in the *Register*; or, if such elements already exist to state where they are to be found.

I am, sir, your obedient servant,
Norwich : August, 1872. J. MAGUIRE.

FUTURE SOLAR ECLIPSES.

Mention is often made in astronomical works about solar eclipses in past ages, but not much about those to come. This has been done with regard to transits of Venus. Delambre has given a list of them for a period of twenty centuries. The following list of future solar eclipses I have computed from some expeditions' tables. Having first tried a great number of known solar eclipses by them, I never found them more than a few minutes out in the time of the greatest obscuration (that of May, 1873, being the furthest out), and the size of the eclipse has always been correct. For instance, they gave the celebrated eclipse of 1140 as not total at London, though it evidently was total in England (see *Astronomical Register*, August, 1871, page 178), an uncovered crescent being left on the sun's south limb, showing the shadow must have gone N. of London, thus agreeing with Mr. Hind's result. As lists of eclipses to the end of this century are given in two or three works, I have commenced with the next. The next great eclipse takes place forty years hence, in 1912. The moon's semi-diameter does not quite equal the sun's, but at London only a narrow crescent on the upper part of the sun's disc is left uncovered soon after midday. One follows in 1921, apparently annular in the northern parts of the kingdom, and is the next central eclipse we shall have in the British Isles. As to the eclipses of the twenty-first century, those of 2026, August 12, and 2081, September 3, seem total in France, that of 2093, July 23, annular in England. On September 23, 2090, there occurs an eclipse which would be total at London but is close upon sunset. I believe this country will see the following total solar eclipses in future ages: (1) that of 1999, described fully by Mr. Hind, (2) that of 2135, October 7, (3) that of 2151, June 14, which appears to include London, totality taking place there about 6.30 p.m., but the central line probably goes N. of the metropolis, (4) one on April 14, 2200, of very short duration.

Column (1) shows date, (2) approximate hour of greatest obscuration, (3) digits or twelfth parts of the sun's diameter obscured, M. signifies morning, A. afternoon.

(1)	(2)	(3)
	h.	°
1905, August 30	... 1 A. ...	10
1908, June 28	... 5¾ A. ...	2
1912, April 17	. 0½ A. ...	11
1914, August 21	... noon ...	8
1916, Feb. 3	... sets eclipsed.	
1919, Nov. 22	... sets eclipsed.	
1920, Nov. 10	... sets eclipsed.	
1921, April 8	... 9 M. ...	10
1922, March 28	... 2¼ A. ...	2
1925, Jan. 24	... 3¾ A. ...	7
1927, June 29	... 5¼ M. ...	11
1928, Nov. 12	... 8½ M. ...	2
1929, Nov. 1	... 11¾ M. ...	1
1936, June 19	... 4¼ M. ...	6
1939, April 19	... 6¼ A. ...	4
1942, Sept. 10	... 4¼ A. ...	4
1945, July 9	... 2 A. ...	7
1949, April 28	... 7½ M. ...	4
1952, Feb. 24	... 9 M. ...	1
1954, June 30	... 0½ A. ...	10
1959, October 2	... 0¼ A. ..	4
1961, Feb. 15	... 7½ M. ...	11
1966, May 20	... 9½ M. ...	6
1968, Sept. 22	...10¼ M. ...	4
1971, Feb. 25	... 9½ M. ...	7
1972, July 10	... 8 A. ...	6
1973, Dec. 24	... sets before the middle.	
1975, May 11	... 6½ M. ...	6
1976, April 29	...10¼ M. ...	5
1982, Dec. 15	... 8¼ M. ...	5
1984, May 30	... 6¼ A. ...	5
1994, May 10	... 6¾ A. ...	6
1996, October 12	... 2½ A. ...	7
1999, August 11	... 10 M. ...	11

S. J. JOHNSON, F.R.A.S.

Upton Helions Rectory,
Crediton: July 27.

Errata. In an article on ancient eclipses in the *Register* for August, 1871, there should be the following corrections: In the eclipse of 733, for ¼ *past* 7, read, ¼ *past* 8; in eclipse of 1133, instead of *further south the eclipse would be total,* read, *further north the eclipse would be total.*

CONNECTION OF METEOROLOGY AND ASTRONOMY.

STORMS.

Sir,—There may be some importance in the fact that some years are more than usually stormy, whilst others are comparatively calm; and it is even possible that some connection may exist between astronomical phenomena and storm periods. From the table which I subjoin, it will be seen that we had a stormy period at the sun-spot maxima of 1860, and now again we are experiencing a large number of storms.

TABLE.

No. of occasions in which the wind moved at the rate of 30 miles per hour, or upwards.

A.D.	No. of Occasions.		A.D.	No. of occasions.	
1852	... 0		1863	... 38	
1853	.. 0		1864	... 26	
1854	... 4		1865	... 58	
1855	... 38		1866	... 23	
1856	... 43		1867	... 21	
1857	... 43		1868	... 20	
1858	... 19		1869	... 17	
1659	... 81	storm period.	1870	... 13	
1860	... 68		1871	... 63	storm
1861	... 73		1872, to July 27th,	30	period.
1862	... 27				

If this stormy condition of the atmosphere extends over the whole hemisphere, or globe, the fact that disasters at sea have been more frequent of late than in 1869, finds an explanation, and if patient investigation should enable us to know when a storm period approaches, something of a practical value would be gained.

The annual amount of rain in inches (discarding fractions), as measured at Toronto, is as follows:—

TORONTO RAINFALL.

Year.	Toronto Rainfall.		Year.	Toronto Rainfall.	
1840	26		1857	33	
1841	37		1858	28	
1842	42	*	1859	33	Wet.
1843	43	Wet.	1860	23	Dry.
1844	19	Dry.	1861	26	
1845	22	*	1862	25	
1846	32		1863	26	
1847	33	Wet.	1864	29	
1848	22	Dry.	1865	26	
1849	32		1866	34	Wet.
1850	28		1867	19	Dry.
1851	26		1868	26	
1852	31		1809	31	
1853	23		1870	33	Wet.
1854	27		1871	23	Dry.
1855	31	Wet.	1872	27	
1856	21	Dry.			

It will be seen that the years of sun-spot max. and min. have been dry, and the preceding years wet, but we defer remarks for a future occasion.

Truly yours,

Toronto: July 25. A. ELVINS.

JEREMIAH HORROCKS.—Enquiry is made in the *Athenæum* as to the parentage of Jeremiah Horrocks, the astronomer, born 1619, at Foxteth, near Liverpool.

COMET I., 1871.

Prof. A. Hall, of Washington, has computed new elements of this comet, based on the whole series of published observations. The elements are as follows:—

Perihelion passage 1871, June 10.62. Berlin M.T.

		°	′
Longitude of perihelion	=	141	37
Longitude of ascend. node ...	=	279	16
Inclination	=	87	35
Log. perihelion distance	=	9·817018	

Motion—direct.

SUN.

Greenwich, Noon. 1872.	Heliographical western longitude of the centre of		Heliographical latitude the sun's disc.	Angle of position of the sun's axis.
	°		°	°
Sept. 1	245·54	+244 δ ξ	+7·22	21·50
2	258·76		7·23	31·75
3	271·98		7·24	21·99
4	285·20		7·25	22·23
5	298·42		7·25	22·46
6	311·64		7·25	22·68
7	324·86		7·25	22·90
8	338·08	+251 „	+7·25	23·11
9	351·30		7·24	23·32
10	4·52		7·23	23·52
11	17·74		7·22	23·71
12	30·96		7·21	23·90
13	44·18		7·19	24·08
14	57·39		7·18	24·26
15	70·61	+258 „	+7·16	24·43
16	83·83		7·14	24·60
17	97·05		7·12	24·75
18	110·26		7·09	24·90
19	123·48		7·07	25·04
20	136·69		7·04	25·18
21	149·91		7·01	25·31

22	163·12	+265 „	+6·97	25·44
23	176·33		—6 94	25·56
24	189·55		6·90	25·67
25	202·76		6·86	25·77
26	215·97		6·82	25·87
27	229·18		6·78	25·96
28	242·39		6·73	26·05
—				
29	255·60	+272 δ ξ	6·69	26·12
30	268·81		6·64	26·19

Assumed daily rate of rotation, 14°·20 + δ λ.

MOON.

LIBRATION. SUN'S PLACE.
Selenographical colong. and lat. of the point on the moon's surface which has the *Earth's* | *Sun's* centre in the zenith.
Greenwich, Midnight.

TERMINATOR.
Selenographical colong. of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets.

					Sunrise.		
1872.	colong.	lat.	colong.	lat.	60° N.	0°	60° S.
	°	°	°	°	°	°	°
					Sunrise.		
Sept. 9	95·55	+0·36	358·24	+1·51	90·9	88·2	85·6
10	94·99	1·92	10·43	1·51	103·0	100·4	97·8
11	94·12	3·39	22·63	1·51	115·2	112·6	110·0
12	92·93	4·69	34·82	1·50	127·4	124·8	122·2
13	91·44	5·70	47·00	1·50	139·6	137·0	134·4
14	89·77	6·34	59·17	1·49	151·7	149·2	146·6
—							
15	88·02	+6·56	71·54	+1·49	163·9	161·3	158·8
16	86·36	6·34	83·51	1·48	Sunset.		
17	84·95	5·70	95·68	1·47	3·2	5·7	8·2
18	83·90	4·73	107·85	1·46	15·3	17·8	20·4
19	83·29	3·50	120·01	1·44	27·5	30·0	32·5
20	83·15	2·11	132·19	1·43	39·7	42·2	44·7
21	83·44	+0·65	144·37	1·42	51·9	54·4	56·8
—							
22	84·12	—0·80	156·55	+1·40	64·1	66·6	69·0
23	85·10	2·17	168·74	1·39	76·3	78·7	81·2
24	86·29	3·43	180·93	1·38	88·5	90·9	93·3
25	87·59	4·52	193·13	1·36	100·8	103·1	105 5
26	88·93	5·42	205·34	1·35	113·0	115·3	117·7
27	90·22	6·08	217·54	1·33	125·2	127·5	129·9
28	91·42	6·48	229·76	1·32	137·5	139·8	142·1
—							
29	92·44	—6·60	241 97	+1·30	149·7	152·0	154·3

Colong. = 90° —λ.

DEATH OF MR. DELAUNAY.—August 12th, 1872. News was received by Sir G. B. Airy of the death of M. Delaunay, Director of the Paris Observatory. Born 1816.

ASTRONOMICAL OCCURRENCES FOR SEPT., 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sun	1		Sidereal Time at Mean Noon, 10h. 43m. 49·35s.	3rd Ec. D.	16 27 5	Saturn. 8 19·3
Mon	2	12 53 19 53	● New Moon Conjunction of Moon and Mercury 8° 57′ S.			8 15·3
Tues	3	 14 39	Sun's Meridian Passage, 55m. 5·37s. before Mean Noon Conjunction of Moon and Venus, 3° 49′ S.			8 11·2
Wed	4			2nd Oc. R.	15 40	8 7·2
Thur	5					8 3·2
Fri	6					7 59·2
Sat	7			1st Sh. I. 1st Tr. I.	15 51 16 26	7 55·1
Sun	8			1st Oc. R.	16 8	Moon. — 4 8·7
Mon	9					5 1·0
Tues	10	2 3	☽ Moon's First Quarter			5 57·4
Wed	11	22 42	Conjunction of Moon and Saturn 3° 13′ N.			6 57·7
Thur	12			3rd Tr. E.	16.30	7 59·9
Fri	13		Saturn's Ring: Major Axis=39″·17 Minor Axis=16″·43			9 2·0
Sat	14	8 27 9 21	Occultation of B.A.C. 7550 (6) Reappearance of ditto			10 1·7
Sun	15	 11 29 12 33 12 46 13 50	Illuminated portion of disc of Venus = 0·959 Illuminated portion of disc of Mars = 0·967 Occultation of τ^1 Aquarii (6) Reappearance of ditto Occultation of τ^2 Aquarii (4) Reappearance of ditto	1st Ec. D.	15 7 49	10 58·1
Mon	16	17 4	○ Full Moon	1st Sh. E. 1st Tr. E.	14 34 15 16	11 51·2

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Tues	17		Sidereal Time at Mean Noon, 11h. 46m. 54·20s.			Moon. 12 41·6
Wed	18		Sun's Meridian Passage, 6m. 5·45s. before Mean Noon	2nd Ec. D.	16 51 27	Saturn. — 7 11·5
Thur	19	13 33 14 46	Occultation of B.A.C. 728 (6½) Reappearance of ditto	3rd Tr. I.	17 11	7 7·6
Fri	20			2nd Sh. E. 2nd Tr. E.	14 53 16 26	7 3·7
Sat	21	4 36	Conjunction of Jupiter and Mars, 0° 36′ N.			αAquilæ — 7 40·6
Sun	22			1st Ec. D.	17 1 31	7 36·7
Mon	23	18 23 11 45 12 45	Conjunction of Mercury and σ Leonis 0° 5′ S. Occultation of 132 Tauri (5½) Reappearance of ditto	1st Sh. I. 1st Tr. I. 4th Tr. I. 1st Sh. E. 1st Tr. E.	14 7 14 56 15 34 16 27 17 1 6	7 32·8
Tues	24	1 21 12 27 13 27	☾ Moon's Last Quarter Occultation of ε Geminorum (3½) Reappearance of ditto	1st Oc. R.	14 37	7 28·8
Wed	25					7 24·9
Thur	26	18 43	Conjunction of Moon and Uranus 3° 53′ S.			7 20·9
Fri	27			2nd Sh. I. 2nd Tr. I. 2nd Sh. E.	14 32 16 16 17 28	7 17·0
Sat	28	5 38 11 54	Conjunction of Moon and Jupiter, 4° 29′ S. Conjunction of Moon and Mars, 3° 56′ S.			7 13·1
Sun	29					7 9·2
Mon	30			3rd Oc. R. 1st Sh. I. 1st Tr. I.	15 36 16 1 16 55	7 5·2
OC Tues	T. 1	6 50	Conjunction of Moon and Mercury, 3° S.	1st Oc. R.	16 36	7 1·3
Wed	2			1st Tr. E.	13 45	6 59·4

THE PLANETS FOR SEPTEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m
Mercury ...	1st	10 23 36	+ 6 28½	10″·2	23 35·9
	15th	10 32 12	+10 0	7″·0	22 49·4
Venus ...	1st	11 33 54	+ 4 16	10″·0	0 49·9
	15th	12 37 4	− 2 53	10″·2	0 57·9
Saturn ...	1st	19 4 29	−22 29	16″·0	8 19·3
	15th	19 3 33	−22 32	15″·6	7 23·3
Neptune ...	1st	1 39 5	+ 8 25	2″·0	14 5·28
	17th	1 37 52	+ 8 17½	2″·0	13 48·7

Mercury rises before the sun throughout the month, and may be well observed. In the middle of the month it rises at one hour and a half before the sun, the interval decreasing to an hour.

Venus is very badly situated for observation.

Saturn may be fairly observed throughout the month, till near midnight.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN SEPTEMBER, 1872.

By W. R. Birt, F.R.A.S., F.M.S.

On p. 179 of the July number of the present volume the value of supplement ☾ — ☉ = on June 20, 1871, is quoted at 148° 10′·3; and on p. 198 of vol. ix. the value of supplement ☾ — ☉ is given as 147° 16′·7 on August 18, 1871; and as 22° 3′·3 on August 31, 1871. On September 5, 1872, supplement ☾ — ☉ = 146° 0′·8; and on the 18th—23° 55′·5. The lists of June and August, 1871, vol. ix. pp. 149 and 198, are consequently available for the selection of objects for observation in September, 1872.

Ninth Zone of objects from North to South, 35° *to* 40° *W. long.*

Arnold, Gartner, Hercules, Römer,* Pyrenees, Capella, Neander,* Vlacq,* Nearchus.*

The objects in this zone, which extends 5° further eastward than the eighth, may be looked for about the 5th day of the Moon's age, September 8. Those marked (*) have not been mentioned in the monthly lists. The following may also be added as not having been inserted in those lists:—Legendre, in zone 2, p. 46 of the present volume; Rheita, in zone 7, p. 175; Rosenberger, in zone 8, p. 199.

SEASON. Summer in the northern hemisphere. The solstice occurs on the 1st.

May I be permitted to offer a remark on the choice of a spot on the Moon's surface, as a fundamental mark in Selenographical investigations?

Perhaps the author of the valuable contributions of the Earth's and Sun's places in the lunar heavens, as regards the Zenith and the position of the terminator, will kindly furnish the express object for which a fundamental mark of reference is desirable? There is certainly much to be accomplished in advancing our knowledge of Selenography, but up to the present moment nothing of any extent appears to have been undertaken according to a well-devised system. There is scarcely anything of greater importance than an increase of *points of the first order*, but nothing has been effected in this department of Selenography since the completion of Mädler's great work; and in extending it a point of reference is not necessary, as each point of the first order is determined independently of every other. A point of reference as to size or magnitude is very important, and the crater *Dionysius* has been chosen for this purpose; a quantity of comparative measures have already been made, now some years since, but they await the means and leisure for publication. Another object for which points of reference in different parts of the Moon's surface are very desirable is that of *relative brightness.* Of such comparisons I have a somewhat large number, also awaiting publication, and ranging between the brightness of the central mountains of Aristarchus and the darkness of the ordinary shadow. The relative brightness of Mosting A has not, I believe, received much attention; B and M record it as 9°.

I may also take this opportunity of suggesting the desirability (for the benefit of the mathematical readers of the *Register*) of the publication of the formulæ by which the positions of the terminator, and of the earth and sun above-mentioned, and also the Heliographical latitude and longitude of the centre of the Sun's disk with the angle of position of the Sun's axis are computed. The reader will find in the Report of the Thirty-sixth Meeting of the British Association for the Advancement of Science, pp. 220 to 238, a list of the points of the first order, with an investigation of the method of determining them, accompanied with the necessary formulæ and an example worked out in full, I need scarcely add that a similar publication of the formulæ for the Moon's terminator, etc.. would be very acceptable.

Errata in article on p. 199, line 7, *August* 13 read *August* 18. Insert — between = and 1° to read = — 1·° 50′·4. Line 10, for *Sautbech* read *Santbech.*

REVIEW.

Scripture and Science not at Variance. By Archdeacon Pratt. Sixth edition. 1871. Hatchards.

The last and much enlarged edition of an excellent work. The mathematical writings of the late lamented author are well known. This volume is remarkable for the calm, dispassionate, argumentative, and convincing treatment of a most important subject.

Errata.—P. 183, line 24 from bottom, for *divisional* read *diurnal;* p. 183, line 6 from bottom, for *discovered about it,* read *discoursed about;* p. 184, line 7 from bottom, for *provision* read *prevision;* p. 186, line 14 and line 19 from top, for *Troerster* read *Foerster.*

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

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Elliott, R.

To Oct., 1872.

Lewis, Rev. H. K.

To Dec., 1872.

Allen. E. G.
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To March, 1873.

Herschel, Professor.

To June, 1873.

Green, Jos.

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JOHN BROWNING begs respectfully to inform scientific gentlemen and the public generally, that he has taken the Premises, No. 63, Strand, opposite Bedford Street. These premises he will open as a West-End branch of his business on the 18th of March. In a Show-room on the ground floor there will be every convenience for testing, or seeing in action, Microscopes, Spectroscopes, Astronomical, Electrical, and other Philosophical Apparatus. There are light workshops on the premises. Communication has been established by electric telegraph with the Factory at 111, Minories. JOHN BROWNING, Optical and Physical Instrument Maker to the Royal Society, the Royal Observatories of Greenwich and Edinburgh, &c., &c., &c., 63, Strand, W.C.; 111, Minories, E.; and 6, Vine Street, E.C. Specialities, Spectroscopes, Astronomical Telescopes, Polariscopes, Microscopes, and Electrical Apparatus.

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The Astronomical Register.

No. 118. OCTOBER. 1872.

ASTRONOMICAL ALLUSIONS IN HOMER, DANTE, SHAKESPEARE, AND MILTON.

BY G. J. WALKER.

I.—HOMER.

When we consider that the Homeric poems, with the exception of the earlier books of Scripture, and some of the Indian Vedas, are more ancient than any other composition known, everything connected with them, apart from their intrinsic beauty, must be of great interest. The object of the first part of this paper is to collect the scattered allusions to the heavenly bodies that are found in these wonderful poems. Regarded in the light of a page of descriptive astronomy, of an antiquity (roundly stated) of 3,000 years, this may not be altogether foreign to the scope of a scientific association.*

Homer seems to have conceived the universe as a hollow globe, divided into two equal portions by the flat disk of the earth; a circular, or as Mr. Gladstone† thinks, an oval disk, having a shorter diameter from east to west than from north to south, and round which flowed the Ocean-river. The superior and inferior hemispheres were respectively called Heaven and Tartarus. The latter was filled with eternal darkness. The concave sphere of heaven is sometimes represented as being of copper (Il. xvii. 425,‡ "all copper"; Il. v. 504; Od. iii. 2), and sometimes of iron (Od. xv. 329; xvii. 565); a variation which may lead to the inference that its firmness and solidity are rather signified than its literal material. Such a *firmament* seems to correspond with the popular view of the ancient Hebrews, except that with them it seems to have been transparent like crystal or sapphire. The following passages from the book of Job may be compared with the Homeric view of the Kosmos; bearing in mind that Scripture speaks according to the appearance of things, and is not to be placed in opposition to true science; nor have the opinions of individuals therein recorded on physical matters of necessity the authority of Revelation:

---

* This paper was read before the Hackney Scientific Association.

† *Studies on Homer and the Homeric Age.*

‡ The edition quoted is that of Bekker, Berlin.

"He hath drawn a circular bound upon the waters,
To the confines of the light and darkness."
Job xxvi. 10. (Barnes.)

"Hast thou with him spread out the sky,
Which is strong, like a molten mirror?"
Job xxxvii. 18.

Even now we often speak of the vault or the canopy of heaven.

On the solid heaven, the stars, in the astronomy of Homer, seem to have been regarded as fixed and to revolve with it; whilst the sun, moon, and the morning and evening stars (regarded as distinct) moved through void air. It is also probable that there was supposed to be an opening in the solid vault through which the peak of Mount Olympus stretched upward into heaven.

THE SUN is invoked as one "Who surveys all things and hears all things," Il. iii. 277; Od. xi. 109, xii. 323. The latter clause, as Mr. Gladstone remarks,* involves impersonation, and he refers to Il. xviii. 239, where the sun is made to set *unwillingly* before the proper time, as the only other instance of the kind in the Iliad. "The untiring Sun" was figured on the shield of Achilles (Il. xviii. 484). His course is called "Lucăbas," or the Path of Light, Od. xiv. 161, xix. 306. The "Turnings of the Sun" are said to be in the Island of Suria (Syra), Od. xv. 404. If this expression refers to the tropics, as undoubtedly in Hesiod in several places, it is difficult to understand it unless by adopting the ingenious explanation which supposes that there was in this island a *parapegma*, *i.e.*, a tablet inscribed with astronomical or chronological observations, a sort of kalendar in which the sun's course and the seasons, &c., were marked. This idea seems to have been adopted by Pope—

"There curious eyes inscrib'd with wonder trace
The sun's diurnal, and his annual race."

Or it may have been a gnomon with the tracings of the shadow paths at the summer and winter solstices. It is curious that long after the time of Homer, Pherecydes (cir. B.C. 500), a native of Syra, is said to have constructed a sun dial on that same island. Something of the sort, very rare or even unique amongst the Greeks in the age of Homer, and probably of Phœnician origin, may account for the allusion in the above passage.

The similes or comparisons derived from the sun are the following: The interior of the house of Menelaus had the "radiance of the sun or the moon," Od. iv. 45. The same is said of the exterior of that of Alcinous, Od. vii. 84. The *khiton*, or tunic, of Ulysses was "bright as the sun," Od. xix. 234. The *pharos*, or shroud, woven by Penelope, was "like the sun or moon," Od. xxiv. 148.

THE MOON.—The "full moon" was represented on the shield of Achilles, Il. xviii. 484, from which "light beamed as from the moon," Il. xix. 374. The horse of Idomeneus had on its forehead a white mark, "running round like the moon," Il. xxiii. 455. The description of a bright moonlight night, Il. viii. 555-60, in Pope's translation, is often admiringly quoted:

"As when the moon, refulgent lamp of night!
O'er heaven's clear azure spreads her sacred light,
When not a breath disturbs the deep serene,
And not a cloud o'ercasts the solemn scene;
Around her throne the vivid planets roll,
And stars unnumber'd gild the glowing pole,

---

* *Studies, &c.*, 2, 261.

> O'er the dark trees a yellower verdure shed,
> And tips with silver every mountain's head;
> Then shine the vales, the rocks in prospect rise,
> A flood of glory bursts from all the skies:
> The conscious swains, rejoicing in the sight,
> Eye the blue vault, and bless the useful light."

"A master-piece" indeed, as Smyth says (Cycle i. 119), but a great amplification of the original, as will appear by comparing the following literal version:

> "As when in the heaven the stars about the shining moon
> Appear very splendid, and the æther is calm;
> And all the mountain peaks are displayed, and the farthest headlands,
> And the dells; and beneath heaven the vast æther is cleft,
> And all the stars are seen, and the shepherd is glad in his heart."

VENUS is the only planet mentioned in the poems. The gleaming of the point of the spear of Achilles* is compared to the

> "Star which moves amongst the stars in the depth of night,
> Hesperus, the most beautiful star that there is in heaven."
> (Il. xxii. 317, 318.)

It is mentioned again, Il. xxiii. 226, as Heōsphoros, the "Bringer of Morn" (the same as Phōsphoros, Lucifer),—

> "Heōsphoros goes forth announcing light over the earth."

And Od. xiii. 93, 94,—

> "When the brightest star had risen, which commonly comes announcing
> the light of Eos, Child of Morn."

Hesperus and Heōsphorus seem to be regarded as distinct in Homer. Pythagoras is said to have been the first to surmise their identity; according to others, Parmenides discovered it.

STARS.—Allusions to and similes from the "starry heaven," Il. iv. 44, viii. 46, xix. 128, Od. ix. 527, are frequent. The arms of Tudeides are described as "shining like fire," and like to the summer [or early autumn] star, which shines with greatest brilliancy when it has been bathed in ocean." (Il. v. 5, 6.) This is Seirius, or the Dog Star. The comparison to fire may possibly justify the inference that Seirius shone in the days of Homer with a deep orange or reddish light. Pope, indeed, settles the point with his

> "Red star that fires the autumnal skies."

But this is not in Homer. Pope often mentions Seirius, and in Il. v. 864-5, he introduces "the rage of burning Seirius," when Homer is only speaking of a thick dark atmosphere produced by a burning wind. But the *name* Seirius does not ever occur in the original. The *Peplos*, vest or shawl, selected by Hecuba, "shone like a star" (Il. vi. 295). So did the one selected by Helen (Od. xv. 108). Astyanax, Hector's infant son, resembled a "beautiful star" (Il. vi. 401). Hector himself, moving about among the ranks of the Trojans, was like

> "The noxious star which appears from among the clouds,
> Very brilliant, and then again plunges into the overshadowing clouds."

Where Seirius is doubtless again meant. Pope renders,—

> "As the red star now shows his sanguine fires," &c.

The breastplate of Achilles was "starry," that is, sparkling (Il. xvi.

---

* A different comparison is that of Dante, *Inferno*, cant. ii., where the eyes of Beatrice are said to be "brighter than the star of day." And *Purgatorio*, cant. xii., an angel is described—

> "With visage, casting streams
> Of tremulous lustre like the matin star."

134), and his horse-tailed helmet "shone as a star" (Il. xix. 381), expanded by Pope into

> "Like the red star, that from his flaming hair
> Shakes down diseases, pestilence, and war."

Apparently understanding a comet. And Achilles himself is beheld by Priam—

> "Beaming brightly, as he hurried over the plain, like the star
> Which goes forth in the late summer, and whose rays, very clear,
> Appear among many stars in the depth of night;
> Which they call also the Dog of Orion.
> The brightest indeed is this one; but it has been created an evil sign,
> And brings much burning heat to poor mortals:
> Thus shone the copper round his breast as he ran."—(Il. xxii. 26-32.)

On the shield of Achilles were represented

> "All the configured stars which gem the circuit of heaven,
> Pleiads and Hyads were there, and the giant force of Orion.
> There the revolving Bear (which the Wain they call) was insculptured
> Circling on high, and in all its course regarding Orion,
> Sole of the starry train which refuses to bathe in the ocean"
> (Il. xviii. 485-89. Sir John Herschel's translation.)

The last verse seems to imply that whatever other constellations were known to Homer, neither the Little Bear nor the Dragon could be among them; since they, as well as the Great Bear, are always above the horizon in the latitudes of Greece and Asia Minor. We know for certain, besides, that the Little Bear was introduced into Greece from the East by Thales.

In Odyssey, v. 271-75, the last three lines just quoted are repeated verbatim. Ulysses at the helm, sailing from the Island of Kalypso, slept not

> "Whilst looking at the Pleiades, and the late-setting Boötes,
> And the She-Bear, which they also call the Waggon,
> Which revolves there and watches Orion,
> And alone is without a share in the bath of the Ocean."

Boötes is called "late-setting," because he descends below the horizon in an upright position, and therefore very gradually.

METEORS.—The descent of Athena from Olympus is compared to

> "A star which the son of wily Kronos sends,
> A portent to sailors or to a broad army of people,
> Bright, and from it many sparks are sent forth."—(Il. iv. 75-77.)

"Pope," remarks Smyth (Cycle i. 213), "makes Homer say, in describing Minerva's rapid descent from heaven, to break a truce between the Grecians and Trojans:—

> 'As the red comet from Saturnius sent
> To fright the nations with a dire portent,
> (A fatal sign to armies on the plain
> Or trembling sailors on the wintry main,)
> With sweeping glories glides along in air,
> And shakes the sparkles from its blazing hair.'

"Now it so happens," he continues, "that there is not a word about a comet in the original; but the simile evidently alludes to a falling star." The Prince of Poets, says, "And she rushed in haste from the peaks of Olympus, as the brilliant star emitted by the son of the sage Saturn, either as a sign to seamen, or to a broad array of hosts, and from which numerous sparks proceed." Pope, save his *trembling sailors*, makes a fine picture; but the passage is another instance showing that

> "Our translators view
> In Homer more than Homer knew."

And, after remarking that "the Middle Ages became the birth-time of the terror inspired by the presence of comets, and that they were deemed portentous among the Romans," he says, "But there is nothing in the more ancient writings to authorise a conclusion that they were regarded as objects of alarm in the earlier ages of the world." As the above is probably the most ancient description of a meteor that we have, it may be interesting to give it also in the version of our illustrious astronomer :—

"Down at once, from the lofty heights of Olympus, she darted ;
As when a meteor sent by the son of mysterious Kronos
(Glides through the air), a portentous sign to fleets and to armies,
Scattering abroad unnumbered sparks (from its fiery tresses),
Thus sped Pallas, Athena," &c.

Pope, however, was resolved to find comets in Homer, for again, Il. iv. 381, when the latter merely says—

"But Zeus hindered, displaying unfavourable signs,"

our great poet has,

————" But Jove forbad from heaven ;
While dreadful comets glaring from afar,
Forewarned the horrors," &c.

ECLIPSES.—There is no allusion to eclipses in Homer, unless the passage, Od. xx. 356-57, "And the sun has utterly perished from heaven, and an evil gloom is overspread," in the vision (or as Mr. Gladstone well terms it, "the magnificent phantasmagoria") of the Seer Theoclymenos, may be supposed to have to have been suggested by such a phenomenon. Eustathius, indeed, supposes the occurrence of a real eclipse, observing also that it was new moon when the festival was being held. But it is evidently only a figure, and rather dubious whether it relates to an eclipse.

In his masterly work already referred to, Mr. Gladstone remarks on the weakness in Homer of the faculties of number and of colour. "The largest number," he says, "which I find in the Poems with any sign of definite use, is that of the fat hogs under the care of Eumaios (Od. xiv. 20). They are 360 ; and, as one is daily sent down to the banquet of the Suitors, they correspond with the days of the year."* The year was probably divided into 12 lunar months of 30 days each. Each month was also commonly divided into two periods according to the increase and decrease of the moon. Months are mentioned, Od. x. 14, xii. 325, xx. 156, xxi. 258. From the new until the full moon was the *beginning*, and while the moon decreased the *ending* of the month. Od. xiv. 162, xix. 307. So in Hesiod.

There are three seasons in Homer : 1. Spring, Od. xix. 529 ; 2. Summer, Od. vii. 118 ; 3. Winter, Il. iii. 4. In Hesiod, whose age is less ancient, the changes of the seasons and agricultural works were determined in a rough way by the risings and settings of Orion, the Pleiades, the Hyades, Arcturus, and Seirius. The heliacal rising of Seirius (*i.e.*, its first visible rising in the morning twilight) in the time of Homer was about the middle of July. Hence its epithet already referred to of "the (late) summer star" (Il. v. 5, xxii. 26). The night was divided into three parts or watches. Thus, Od. xii. 312, xiv. 483,—

"But when it was the third watch of the night, and the stars had passed
over,"

i.e., completed their nightly course and disappeared in the twilight.

After an elaborate investigation, Mr. Gladstone concludes that, whilst Homer had a very vivid perception of light not decomposed, as varying between light and dark, white and black, his perceptions of colour were very indeterminate, and he has no words which can certainly be held to mean orange, green, and blue. The only two places, Il. xi. 27, xvii. 547, in which the rainbow is mentioned support this conclusion. If the great poet's grasp of number was so feeble, as it seems to have been, we may presume that he would have had difficulty in comprehending the famous catalogue of stars made by his illustrious countryman Hipparchus, about a millenary of years after his time; and, perhaps, yet greater difficulty in appreciating such a chromatic scale of their colours as the late Admiral Smyth devised.

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* Juventus Mundi, p. 538.

NOTE.—How the sun passed from west to east does not appear in Homer. Between the notions of his reviving and perishing every day, as held by Epicurus, and of his shining in other regions when he has left our own, Lucretius and Virgil both hesitate. Mimnermus (cir. B.C. 600) is the first who records the myth that the sun after setting is carried round the earth in a golden bowl (made by Hephœstos) along the Ocean-river, back again to the east. This is also related by Stesichorus who lived about the same time.

II. DANTE.

Born A.D. 1265; d. 1321.

Amidst the numerous astronomical allusions in this great poet, it will suffice to select a few: for we have not here the antiquity which makes the least fragment of Homer interesting; and the learned Florentine knew nothing better than the Physics of Aristotle, and the system of Ptolemy. At the end of the "Inferno," Dante, having descended through the different stages of the infernal regions, describes the great effort required to pass from one side of the earth's centre to the other. His guide, Virgil, explains to him,

—"When I turn'd, thou didst o'erpass
That point, to which from every part is dragg'd
All heavy substance.'*

On which one of the commentators remarks that, "if this passage had chanced to meet the eye of Newton, it might better have awakened his thought to conceive the system of attraction, than the accidental falling of an apple;" which does not seem to evince much acquaintance with our immortal philosopher's real discovery.

On issuing from the interior of the earth, at the antipodes of Jerusalem, near the isle and mountain of Purgatory, the poet says,

"To the right hand I turn'd, and fix'd my mind
On the other pole attentive, where I saw
Four stars ne'er seen before save by the ken
Of our first parents. Heaven of their rays
Seem'd joyous. O thou northern site! bereft
Indeed, and widow'd, since of these deprived."
(Purgatorio, cant. i.)

That this refers (besides the mystic sense) to what is now called the "Southern Cross," there can be little doubt. Its four principal stars originally formed part of the Centaur. Humboldt, quoting the above celebrated passage, observes, "Dante and Amerigo Vespucci,—who at the aspect of the southern firmament in his third voyage first recalled these lines, and even boasted that 'he now beheld in his own person the four stars never before seen save by the first human pair,'—were still unacquainted with the denomination of 'Southern Cross.' Vespucci says simply that the four stars form a rhomboidal figure (una mandorla); and this remark belongs to the year 1501. As sea voyages round the Cape of Good Hope and in the Pacific Ocean, by the routes which Gama and Magellan had opened, multiplied, and as Christian missionaries pressed forward into the newly-discovered tropical lands of America, the fame of this constellation increased more and more. I find it first mentioned as a 'wondrous cross (croce maravigliosa), more glorious than all the constellations of the entire heavens,' by the Florentine Andrea Corsali (1517), and afterwards in 1520 by Pigafetta. The Florentine extols Dante's 'prophetic spirit,'—as if the great poet had not possessed as much erudition as creative genius,—as if he had not seen Arabian celestial globes, and held communication with many Oriental travellers from Pisa."*

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* Cary's translation is used throughout.

As the date of the celebrated "Borgian Globe" is A.D. 1225, Dante might have seen either it or another similar one, when the "Southern Cross" was still placed on the hind quarters of the Centaur. Allowing for a certain degree of poetic license, perhaps the first idea suggested by the above passage is the disappearance of the Cross from northern latitudes, owing to the precession of the equinoxes, first discovered by Hipparchus. But, besides that this constellation was still visible at Alexandria in the time of Ptolemy, it must be borne in mind that Dante places the terrestrial Paradise on the summit of the Mount of Purgatory in the Antarctic Ocean, and makes Adam declare (Paradiso, cant. xxvi. end.) that he was in it only six hours. Notwithstanding, then, that the poet speaks of our "widow'd northern site," "bereft" of this constellation, it seems plain he wishes to be understood that the north never enjoyed the sight of it,—a sight the beauty of which is enhanced by the intensity of light of the Milky Way in its vicinity. As Capt. Jacob, quoted by Humboldt,† says, "Such is the general blaze of starlight near the Cross from that part of the sky, that a person is immediately made aware of its having arisen above the horizon, though he should not be at the time looking at the heavens, by the increase of general illumination of the atmosphere, resembling the effect of the young moon." All who have had the opportunity of seeing the southern heavens will recognise the truth of this description; but, admitting that we have nothing to show in our latitudes like it, nor anything like the unique spectacle of the Magellanic clouds, and the "coal sacks," the view of our heavens looking south, when Orion is on the meridian, goes far to make amends for our loss and "widow'd condition."

In Purgatorio, cant. viii., we read,

"My insatiate eyes
Meanwhile to heaven had travel'd, even there
Where the bright stars are slowest, as a wheel
Nearest the axle; when my guide inquired:
'What there aloft, my son, has caught thy gaze?'
I answer'd: 'The three torches, with which here
The pole is all on fire.' He then to me:
'The four resplendent stars, thou saw'st this morn,
Are there beneath; and these, risen in their stead.'"

The Milanese astronomer, De Cesaris, considered that the three torches were Canopus, Achernar, and Fomalhaut;‡ and this (besides their mystic sense) appears very probable. Of these fine stars, almost in a line with each other, Achernar is the central one, and nearly equidistant (about 49°) from the other two. Adjusting the globe to Lat. 32° S., it will be found that when the Cross has set, Achernar is approaching the meridian; Fomalhaut, which passes very near the zenith, is high up in the east, and Canopus declining in the west.

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* Cosmos, 2, p. 292.
† Cosmos, 3, note 254, lxv.
‡ Cosmos 2, xcv.

The Milky Way is mentioned, Paradiso, cant. xiv.

> "As leads the galaxy from pole to pole,
> Distinguish'd into greater lights and less,
> Its pathway, which the wisest fail to spell;'—

And different opinions about it Dante instances in the "Convito." The telescope of Galileo revealed its true nature; but that had been divined two thousand years before by Democritus, and by Manilius at the beginning of the Christian era.

The description of a meteor, Paradiso, cant. xv., is interesting to compare with Homer's.*

> "As oft along the still and pure serene,
> At nightfall, glides a sudden trail of fire,
> Attracting with involuntary heed
> The eye to follow it, erewhile at rest;
> And seems some star that shifted place in heaven,
> Only that, whence it kindles, none is lost,
> And it is soon extinct."

The following curious mode of expressing a moment of time occurs in the opening of the xxix. canto of the Paradiso:—

> "No longer, than what time Latona's twins
> Cover'd of Libra and the fleecy star,
> Together both, girding the horizon hang;
> In even balance, from the zenith poised;
> Till from that verge, each, changing hemisphere,
> Part the nice level; e'en so brief a space
> Did Beatrice's silence hold."

"Latona's twins" are, of course, Phœbus Apollo and Artemis, in the post-Homeric mythology equivalent to the sun and moon. The "fleecy star" is Aries. The moon is on the horizon, precisely in opposition to the sun, likewise on the horizon: as Mr. Cary says in his note, "As short a space as the sun and moon are in changing hemispheres, when they are opposite to one another, the one under the sign of Aries, and the other under that of Libra, and both hang, for a moment, poised as it were in the hand of the zenith."

In Paradiso, cant. ix., the shadow of the earth is said to reach as far as Venus. There are allusions to the spots on the moon in the Inferno, cant. xx.

> "But onward now:
> For now doth Cain with fork of thorns confine
> On either hemisphere, touching the wave
> Beneath the towers of Seville."

"By Cain and the thorns, or what is still vulgarly called the Man in the Moon, the poet denotes that luminary" (Cary). And in Paradiso ii. the "fabling quaint" about Cain is followed by Beatrice's explanation of the spots,—as little worth attention as that of the Angel to Adam in Paradise Lost, v. 420. On "the Man in the Moon," most nations have traditions. Grimm in his Deutsche Myth. has collected a great many. (*English Cyclop.*) The Indians fancied the figure of an antelope or gazelle in the moon; a resemblance not very far-fetched: hence the Sanskrit names for the moon, Mrigalanchana and Mriganka, signifying that which has the mark or sign of an antelope; Mriga being an antelope.

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* And Virgil's. Georg. i.

> "Oft shalt thou see, ere brooding storms arise,
> Star after star glide headlong down the skies,
> And, where they shot, long trails of lingering light
> Sweep far behind, and gild the shades of night."
> Sotheby.

EXTRACTS FROM GENERAL OBSERVATIONS ON THE TOTAL ECLIPSE OF DECEMBER THE 12, 1871.

By R. F. Chisholm, F.R.I.B.A., &c., &c.,
Consulting Architect to the Government of Madras, and Member of the Avernashy Eclipse Expedition.

The telescope used was an excellent one by Cooke. After describing the preparations made for the observation, and the first part of the eclipse, the writer says, "After watching for a few moments the jagged edge of the descending moon's limb, I turned to observe the scene around me. The whole aspect of nature had changed. The greens on my right hand had become paler and bluer, a cold violet tinged the lights, and all shadows were sensibly darkened.

The *unearthly* aspect so often described during eclipses seems to me more due to the absence of diffused light than to actual change of colour. Comparing my sun-lit view with the scene before me, it was as if a gigantic electric light had been substituted for the sun. Turning again to the celestial bodies, the progress of the moon, hitherto so slow, gained apparent rapidity with every moment, and the excitement of watching it was not unlike a prolongation of that experienced at a well-contested horse-race, where the distant horses which appear to move so easily gain speed at every stride, until they rush by with bewildering rapidity. Here, as I watch, the moon appears to close down faster each succeeding moment; a low-lying plateau on the north cusp ending in a high excrescence now detaches a narrow strip of light,—a moment obliterates it! Through a deep valley glistens a bead of light, almost instantly blotted out by the surrounding lunar mountains!—Only a fine thread of sunlight remains—it breaks into beads of light, which vanish like the fading sparks on a piece of charred paper. A moment's hesitation, and I drop the dark glass. A fitful glimmer of direct sunlight quivers for a moment like the last muscular action of life—and dies, as the majestic sweep of the corona gives birth to a new and more beautiful existence—while, instantaneously with this marvellous change, the pall-like shadow passes by and casts everything in gloom—for a moment, earth, moon and sun are linked together by light and shadow! and then, all is still!—nature has reached a point of perfection, and seems to pause! Up to the instant of totality, the motion of the heavenly bodies had been so rapid that fancy almost created a sound; you fancied you heard the whirl of the moon rushing on through space—the lessening roar of the fierce solar rays as the two orbs, momentarily folding together, moved slowly over the deep blue of the sky, while a chance cool breeze gave intense reality to the rush of the shadow, sweeping on at the rate of some 40 miles a minute,—and now, all seems perfectly still! not a gleam on the moon's edge,—not a flicker in the corona,—no alteration in either the positions or lengths of the streamers,—no variation in the surrounding scene. For two minutes and nine seconds, until the entombed sun bursts forth into new life with startling suddenness, like the explosion of a meteor of unprecedented brilliancy, the scene seems wonderfully typical of the stillness of death!

Perhaps the most astonishing sensation during totality arises from the additional glimpse obtained of creation. We are, as it were, taken behind the scenes, and permitted to see a portion of that marvellous and everlasting machinery which produces light, warmth, and life,—to gaze on flames of incandescent hydrogen, thousands and thousands of miles high, inexhaustable and unquenchable fire! And when we reflect that this mass of blazing, burning matter emits so feeble a light at this enormous distance, that the sensitive retina is not even momentarily pained by looking at it, the mind fails to grasp any conception of the intense heat and brilliancy of that underlying photosphere, the slightest chink of which can only be looked at through a dark glass!

For a few seconds after totality, I could not remove my eye from the telescope, the scene was too novel. I was struck particularly with the exquisite softness of the whole phenomenon, and the tender tones of colour. I had not for one moment imagined that the moon would be an 'intensely black object' surrounded by a fringe of 'dazzling brilliancy,' hence I had prepared the series of diagrams noted above; but I was a little startled to find it appear a comparatively light tint of delicate brown, surrounded by mellow tints of exquisite softness. The whole effect was one of rich harmonious warmth. The prominences (chiefly crimson and orange) were defined clearly, and the corona, a yellowish orange light near the sun, passed through violet into the cold neutral of the sky. After gazing for a few seconds I attempted to sketch the two lower flames, one of which was particularly striking; but unfortunately my hand shook so with the previous excitement that I could do little more than indicate their position, and sketch the flames themselves on a larger scale. Taking a second good look to be certain of their position and colours, and noting two more I had not previously seen, I rose to take a look round at nature. All the *unearthly* appearance had vanished during totality, and the landscape had been changed to twilight with the first streaks of morning round the horizon. Venus in the zenith, and the few larger stars, looked exactly as these bodies look during twilight, except that the sky had lost that depth of blue common to such moments. It was as if a light film of Indian ink had been washed over a representation of early morning. The eclipsed sun shedding its soft streamers round our darkened satellite, decidedly gave place in brilliancy to Venus. There was still a good deal of diffused light, and I turned to my boards to see whence it came. Only the east side of the vertical board was illuminated; and this with peculiarly the same tone and strength that I had observed before sunrise. I at first imagined this to be the light of the corona. Had it been so, however, the sun being some 20 degrees above the horizon would certainly have illuminated the upper part of the horizontal board. It appeared, then, that the whole amount of appreciable light came from the strip of apparent dawn below the line of clouds; that it was, in fact, the sunlight surrounding the shadow, reflected back in the air, and viewed through a medium of some 35 miles of dark atmosphere. If this surmise be correct, we can readily perceive the cause of the apparent discrepancies which exist between different observers in describing the relative effects of darkness. The light of the earth's reflection would diminish so rapidly with the altitude, that it would seem to me possible for a zenith eclipse, wholly obscured by dark clouds, with a clear horizon, to be as light as a fine summer morning before sunrise; while, on the other hand, an eclipse with a clouded horizon, *within the circle of shadow*, might be as dark as the darkest starlight night. As a further proof of the very feeble light of the corona, may be noted the fact, that the eye, although weakened by gazing for some 15 minutes through a dark glass, is not even momentarily put out by the burst of the corona; while a telescope of ordinary power, brought suddenly to bear on the moon, renders it too bright to be looked at without a painful sensation.

I noticed that the corona, by the unaided eye, appeared a soft yellowish light, almost colourless. Remembering the expression of warmth I saw in the telescope, I again looked through the instrument: by this time the moon had moved half out of the field, and I saw the full breadth of the south-west portion, which was most decidedly a yellowish orange, fading through violet into the surrounding darkness. A fringe of crimson prominences on the west warned me of the progress of the phenomenon, and I proceeded to compare my landscape with the actual view in the camera. Both being on the same scale, the comparison was peculiarly easy; indeed, I think the precautions I took unnecessary. Any one accustomed to sketch from nature could with ease have retained the scene by memory. I had just seized my pencil with the intention of tracing the streamers and corona. I had marked the moon, the corona, and one streamer, when the first blaze of sunlight burst forth; I had thus an opportunity of seeing the whole effect of this burst concentrated on a few square inches of paper. By the time I had collected my drawing materials it was light enough to commence work; and in three hours I had completed sketches of the landscape and corona, sufficiently close to enable me to represent very fairly the observed phenomena.

The figure of the corona was not regular; neither were the streamers placed symmetrically. The greater breadth of the former appeared to be on that side towards which the sun was approaching.

NEW EQUATORIAL TELESCOPE FOR THE ROYAL OBSERVATORY.

(From *The Scotsman.*)

The insufficiency of the equatorial telescope in the Royal Observatory Calton Hill, for the requirements of modern astronomical science, has long been a matter of notoriety, and Professor Piazzi Smyth has not for twenty years ceased to urge upon every successive government the necessity of raising the metropolitan observatory of Scotland from the position of the meanest appointed government institution in Europe. The perseverance of the Astronomer-royal for Scotland was at length rewarded, and last year a sum of 2,300*l.* was placed in the estimates for the purpose of providing an improved equatorial telescope. But after Parliament had ratified the proposal of the government, that a new instrument should be secured for the observatory of the Scottish metropolis, a limit was put on the aspirations of the Astronomer-royal as to the size of the telescope. The new telescope, of course, involved a new dome, and it was referred to an architect of taste to see how much the new dome to be placed on the beautifully proportioned building on the Calton Hill should exceed the old one in size. The architect selected by the government was Mr. James Fergusson, the author of "The History of Architecture," and he decided that the new dome could not be raised more than fourteen inches—that being the largest increase that could be æsthetically allowed in conjunction with the rest of the Observatory, which, viewed as a piece of architecture, is considered to be the very gem of the works of the late William Playfair. In consequence of this the Astronomer-royal has had a difficult task in endeavouring to arrange a form of equatorial instrument which would give a greater amount of power within a smaller line or compass than was ever attained before. The new telescope will have an aperture of two feet upon a focal length of only ten feet, a larger diameter in proportion to focal length than any astronomical telescope yet introduced into any observatory, and it will no doubt be by far the most powerful instrument ever erected under so small a dome. Although the telescope will be much more powerful than any ever before placed in the Observatory, it is still not such as was desired or considered almost necessary in the present state of science. The instrument, which is being built by Mr. Howard Grubb, Dublin, is to be of a comparatively new order of reflecting telescope. The old reflecting telescopes, such as those of Lord Rosse, had their reflectors made of a mixture of copper and tin. Mons. Foucault, of the Paris Observatory, the celebrated inventor of the pendulum experiment for determining the revolution of the earth, discovered that a better reflector could be secured by making the body of the speculum of glass, and then coating it by a chemical process with pure silver. The new Edinburgh telescope will have one of these glass silver-covered speculums. The instrument is intended to be employed in two comparatively new branches of observing astronomy—photography and spectroscopy. Both these classes of research require the seemingly impossible accompaniments—that the telescope must have the utmost amount of firmness, and also have the most accurate possible movement, at the same rate at which the stars are going round in the sky. For if, during the time that an observation is being proceeded with, the slightest tremor or shaking should happen, or if an error in the movement of the telescope in its arc, with a radius of five feet (half the length of the telescope), should occur to the amount of even one three-hundredth part of an inch, the star and its spectrum would entirely vanish from the field. Notable features in the new telescope will, therefore, be the remarkably perfect clock-work apparatus, the several devices connected with the prisms of the spectroscope, the means by which not merely celestial objects will be kept in view, but those by which the rays of chemical flames will be brought into comparisou with the light of the stars. The extremely delicate measuring apparatus, to be applied to the respective subjects as they appear on the spectrum. will also be noteworthy. December next is the time fixed for the completion of the new instrument, but meanwhile active preparations are being made in the Royal Observatory for its reception. The old wooden dome which surmounted the building has been removed, and Playfair's grand pier, resting on the solid rock, is being furnished with a new capital to suit the increased size of the new telescope. The new dome, it is expected, will be erected in the course of next month, while the weather is yet fine. This dome, which is also being built by Mr. Howard Grubb, Dublin, will be of iron instead of wood, and that for two reasons: first, because it will afford a greater amount of space in the interior of the instrument room; and second, because it will enable such an arrangement being made for the shutter, as will allow of an opening several feet in breadth, whereas the opening in the old dome was only a few inches wide. The new works involve a considerable amount of alteration, especially in the interior of the Royal Observatory, and these, so far as archictural points are concerned, are being carried out under the efficient supervision of Mr. R. Mathieson, of Her Majesty's Office of Works in Edinburgh. Although the arrangements of the observatory are, during operations, necessarily somewhat upset, observations continue to be made by Professor Piazzi Smyth and his assistants. Nothing is allowed to interfere with the usual time signals which emanate from the Observatory daily.

We are informed by the Astronomer Royal that the new dome alluded to is now erected and admirably fulfils all the expectations formed of it, such as increased space inside, greater ease of revolution, larger and more easily worked shutter, better ventilation, and freedom from vibration and bumping. This latter curious quality was a very vicicus propensity of the old dome, partly from its being mounted on cannon balls which enabled it to roll in every other direction as well as in that of the line of railway, wherein alone it was wanted to roll; and partly from the unprecedentedly windy and stormy exposure of the Edinburgh Observatory on the summit of the Carlton Hill. The new dome, therefore, may be considered a very creditable piece of engineering, and a decided success on the part of Mr. Howard Grubb, who is admirably keeping up the credit of the great optical and instrumental establishment founded by his eminent father in Dublin.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

NOTE ON APPENDIX TO DR DE LA RUE'S ADDRESS TO THE BRITISH ASSOCIATION (SECTION A.), *BRIGHTON MEETING*, 1872.

This appendix states that Professor Zöllner finds "gas-density on the earth's surface 10^{246} times greater than in space; that a litre of former would fill a sphere of latter's density, whose radius would be traversed by light in not less than 10^{98} years, and that the air round the moon is 10^{332} times less dense than at earth's surface."

Are these enormous *exponentials* correct? Light, moving at 192,000 miles a second, will traverse in a year of 31,000,000 of seconds, a line of 5952×10^9 miles, or above $\frac{3}{8} \times 10^{18}$ inches; the radius of a sphere whose volume is $883,227 \times 10^{33}$ cubic miles $= 22\frac{1}{8} \times 10^{346}$ cubic inches.

A litre contains 61,0270772 English inches, which as a sphere gives a radius of

$$\sqrt[3]{61. \ldots \times \frac{3}{4\pi}} = 2.44237 \text{ inches};$$

a density of 10^{-246} gives a radius of $244,237 \times 10^{77}$ inches $= 385475 \times 10^{74}$ miles; results do *not* agree, even introducing the factor $800 =$ density water to that of air. I believe Sir William Herschel showed that if the stars revolved (*à la Ptolemy*) round the earth, one at an annual parallax of a second of space would make a diurnal revolution of $206265.19.10^7\ \pi$, or 1231.10^{11} English miles, a *moderate* estimate, compared to the above ungraspable magnitudes.

74, Offord Road, N.: S. M. DRACH.
August 21, 1872.

ANCIENT ECLIPSES.

My dear Sir,—Referring to the contents of the slip you have sent me, the correct date of the eclipse of 1433, is June 17; there was a misprint in a recent communication of mine in *The Times*. The *central line* did not touch England, it passed from Stornaway (Lewis) to Abroath. The *southern* limit of totality ran from about five miles North of Carlisle to Spurn Head, at the mouth of the Humber. The 17th of June, in 1433, fell on *Wednesday*.

Ferguson says nothing to justify the inference that any one of the three eclipses named was total in England; indeed, the eclipse of 1633, October 3, was *annular*, though I see it is given total in Ferguson's list.

While writing on this subject I may just mention that the eclipse of 878, October 29, in the days of King Alfred, to which attention was lately directed by the Rev. J. S. Johnson, comes out total in London by a rigorous computation. I find totality began at 1h. 16m. 20s. mean time, and continued 1m. 51s. The shadow ran thus, near our meridian:—

	N. limit	Central line	S. limit
Long.	Lat.	Lat.	Lat.
1°W	+53°.18′	+52°. 5′	+50°.56′
0°	53 · 1	51 .48	50 .40
1°E	52 .45	51 .33	50 .25

London, therefore, some 20 miles south of the central line.

I am, dear sir,
Yours very truly,
J. R. HIND.

Mr. Bishop's Observatory,
Twickenham, 1872, August 28.

Much having been recently published on the subject of historical eclipses, it may not be inopportune to continue a brief description of those recorded in the Saxon Chronicle. For such a purpose it will hardly be deemed necessary to have the time to the nearest second; but if it should be within even a quarter-of-an-hour or so, it will suffice. The following eclipses have been computed from the same tables I used for the "Future Solar Eclipses." Though expeditious, they afford a very fair approximation to the time. Having already commenced this subject in No. 104 (to which two corrections at the foot of page 220 in September's *Register* should be applied), I shall omit the eclipses previously mentioned, —those of 733, 828, 1110, 1117, 1133, 1140. The translation of the Saxon Chronicle used is Ingram's (1823).

"538. This year the sun was eclipsed 14 days before the calends of March, from before morning until nine." An eclipse of the sun on the morning of February 15th, appears to have attained its greatest obscuration at London about 7h. 43m., and that was 8 digits.

"540. This year the sun was eclipsed on the twelfth day before the calends of July, and the stars showed themselves full nigh half-an-hour over nine."

I make the sun's eclipse on the morning of June 20th to have amounted to two-thirds on the lower limb about 7h. 37m. Sem. of sun almost as small as possible. Sem. of moon about as large as it could be. Totality must have been far south of Great Britain.

"664. This year the sun was eclipsed on the 11th of May; and Erkenbert king of Kent having died, Egbert his son succeeded to the kingdom."

On May 1st I find a very large partial eclipse of the sun, the maximum obscuration soon after 5h. in the afternoon, when only a thin crescent would be uncovered at the S. of the sun. It must have been total in England north of London.

"795. This year was the moon eclipsed between cock-crowing and dawn on the fifth day before the calends of April, and Erdulf succeeded to the Northumbrian kingdom on the second before the Ides of May."

The eclipse meant must be that of March 28, 796. It began about 4h. in the morning, was total for nearly an hour, and ended below the horizon about half-past 7. The moon would set totally eclipsed.

"800. This year was the moon eclipsed at eight in the evening on the 17th day before the calends of February, and soon after died King Bertram and Ealdorman Worr."

An eclipse of the moon on the evening of January 15 began at 7h., middle about 8h. 34m, the obscuration being nine-tenths of the moon's upper limb. End about 10h. 8m.

Upton Helions Rectory, S. J. JOHNSON, F.R.A.S.
Crediton: Sept. 3.

NEW MINOR PLANETS.

(121) May 12th, 1872, by Mr. Watson—Michigan.

(122 and 123) July 31st, 1872, by Dr. C. H. F. Peters—Hamilton College.

(124) August 23rd, 1872, by Dr. C. H. F. Peters.

(125) September 11th, 1872, by M. Prosper Henry, of the Observatory, Paris.

Dear Sir,—This year promises well for the minor planets, those modest *sorores minores*, who now and again woo our attention by additions to their number. The 8th, of 1872, whose number in the group is (125) disclosed itself on the night of September 11th, at the Observatory of Paris, to the watchful eye of M. Prosper Henry. We should welcome this new accession to our astronomical wealth, and also this new planet-finder, and nothing the less because he is of the old world, which needs much to have its bands of observers and labourers recruited.

During the past ten years our obligations, as regards the subject of M. P.'s, are mainly due to our very worthy cousins of the new world.

Our leading members at home, especially those of the R.A.S., have of late given their attention very much to physical astronomy, and doubtless our science is deeply indebted to the spectroscope (what a mongrel appellative—the former part plainly *Latin* and the latter pure *Greek*), to photography and to chemistry; but surely we should not receive with indifference the announcements from time to time of new planets discovered, even should they be minor planets. Most of us remember the joy and rejoicing with which Astræa was welcomed, in 1845, and we all have read of the sensation and delight produced by the discovery of Ceres on the first day of this century. Surely, surely, the many additions in our day to that central group of planets call on us to give especial attention to them. The idea which was, for a long time, very general that these planets were fragments of one great body broken up by some convulsion, is now entertained by few. That theory is nearly exploded. Is it not reasonable that we should think-out some other,—*try again* sounds in our ears. May I hope, Mr. Editor, that your next number will contain some thoughts on THE MINOR PLANETS, thus making some atonement for past neglect and gratifying many of your humbler astronomical readers, especially your aged friend

Angela Gardens, Sept. 16th, 1872. SENEX.

TWO NEW DOUBLE STARS IN SAGITTA.

I desire to call attention to two new double stars near 14 Sagittæ, lately discovered with my 6-in. Alvan Clark refractor, one of which is a very beautiful but excessively difficult object. As this vicinity is particularly rich in double stars found by Struve, I give a diagram of all of these doubles, together with the brighter stars in their neighbourhood. The five from Struve, and 14 and 15 Sagittæ, are set down to scale for the epoch of *mensuræ micrometricæ* (1830), and the other stars carefully marked in. The new doubles are marked X and Y, and Struve's A, B, &c.

The position, angles, distances, and magnitudes of the several doubles in Struve shown on the map* are as follows:—

A=Σ2616	P=265°·7	D=3″·3	Mags.	6·8	9·7
B=Σ2618	115·9	5·3		8·6	8·9
C=Σ2622	194·8	6·2		8	8·7
D=Σ2634	13·8	6·5		8	9·5
E=Σ2651	279·9	1·5		8	8

2616 is a very beautiful pair, and perhaps the most difficult of the five. 2651 is also very pretty, but easy. Dembowski has observed another pair on the same parallel with 2618, of which he gives:—

P=213°·8 D=21″·65 Mags. 7·7 10·5 (*Ast. Nach.*, No. 1736.)

This will be found in the same field a little preceding. It is an easy but interesting double. The star marked F is also a wide double, resembling the last.

The first of the new doubles, X, is vastly more difficult than any of those cited; indeed, it seems to be one of the most difficult objects I have found, or been able to see, with my aperture. The magnitude of the primary is the same as Σ 2616, or about 7·5 of the scale of Smyth and Herschel. The distance of the companion is about 2″. The same evening I picked up two doubles in Cassiopea, afterwards identified as O Σ 511 and O Σ 512, the magnitudes being given as 11·12 and 11, which I found much easier than the one in question. The distances, however, are greater, being 10″·4 and 4″·14 respectively, for which some allowance should be made; but still they are both rather difficult. From this and other comparisons, including Σ 2616, which is certainly more than one magnitude brighter, I think the new double might be fairly rated as 11, giving nearly 16 of Herschel's scale.

The other pair, about 8 mag., marked Y, is comparatively easy. The companion is a very minute point, and fainter than any of Struve's, yet from its considerable distance from the principal star, about 10″ is very readily seen. I hope astronomers will observe these objects, particularly the first, and report, with measures or otherwise.

I may add that, being absent from home, I am obliged to use, temporarily, my object glass without the tube and mounting, and possibly may overrate the difficulty of the first pair from the very rude apparatus used, the object glass being simply fastened to one end of two narrow pieces of boards nailed together, with their planes at right angles, and the eyepiece attached to the other end. Although extremely unsteady, and requiring very frequent adjustment of the object glass, and inconvenient generally to use, it seems to answer all practical purposes.

S. W. BURNHAM.

Aug. 19th.

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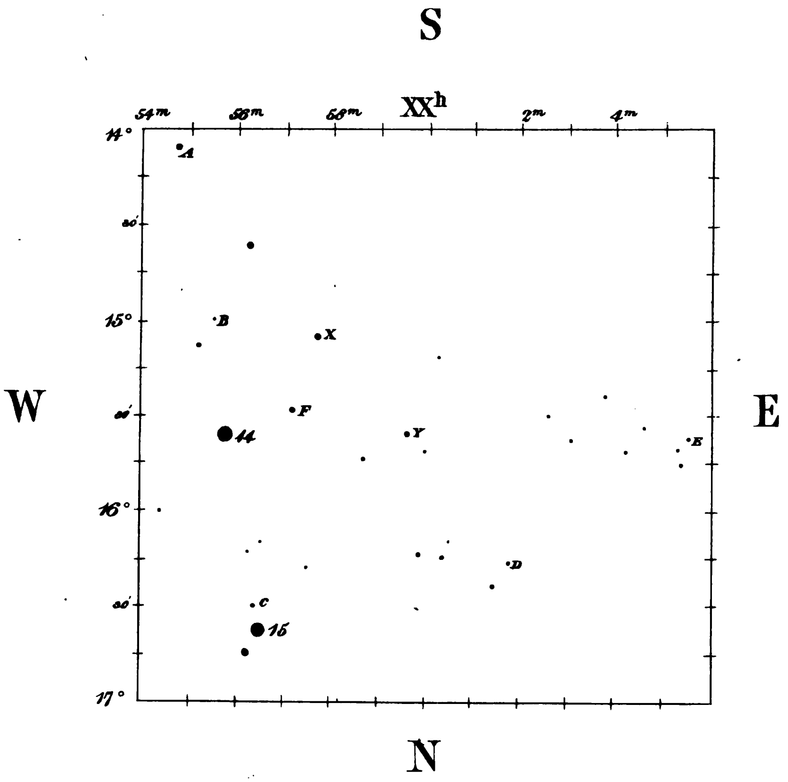
* *Vide* frontispiece.

MAP SHEWING THE POSITION OF TWO NEW DOUBLE STARS IN SAGITTA.

Vide page 244.



THE PLANET MERCURY.

Sir,—I have read with much pleasure the correspondence that has recently appeared in the *Register* having reference to observations of Mercury, and quite agree with Mr. S. J. Johnson that this planet can be much more frequently seen with the unassisted eye than is generally supposed. In February, 1868, I saw the planet three times, viz.; on the 15th, 19th, and 24th, and. in February of the following year, I saw it on the 2nd, 4th, 5th, and 6th. When I first observed the planet I was surprised at its brilliancy, which seemed to nearly equal that of Jupiter in February, 1868. On the 15th these planets were in close proximity, and therefore a favourable opportunity occurred to estimate their relative brightness. Mr. Hind has stated that Mercury, under the most favourable circumstances, appears like a star of the third magnitude ; but there is good reason to suppose that the planet is much brighter than this. Mr. G. J. Walker says (*Astronomical Register*, vol. VI. p. 74) "it seemed to vie with Jupiter in splendour" on February 19th, 1868. I saw the planet on the same evening, and wrote in my note book: "Feb. 19th. Soon after Jupiter had set Mercury emerged from the clouds, which almost entirely overspread the sky except the western horizon, which was remarkably clear. The brilliancy of the planet surprised me, for he appeared to nearly equal Jupiter." On other occasions also he has been quite a conspicuous object near the horizon, and I am inclined to believe that his brilliancy is much greater than is usually imagined, and that the planet can be very easily seen (when sufficiently distant from the sun) under favorable atmospheric conditions.

I am, Sir, Your obedient servant,

Hollywood Lodge, Cotham Park, WILLIAM F. DENNING.
Bristol: August 2, 1872.

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15 *MESSIER PEGASI.*

Sir,—We are indebted to the late Sir John Herschel for graphic descriptions of many of those splendid collections of suns which are usually designated globular clusters, and I hardly need to apologise for transcribing his word—portrait of one of the most interesting, whose name is mentioned above.

He says: Very bright, very large ; gradually brighter, and very suddenly much brighter in the middle. A magnificent globular cluster comes up to a perfect blaze in the centre, like a protuberance or ripple ; not the condensation of a homogeneous globe ; it has straggling streams of stars, as it were, drawing to a centre. . . . Superb, very compressed, irregularly round ; very small stars 15 mag., all distinct, but running together into a blaze in middle ; 4′ or 5′ diameter.

Results of observation with the Parsonstown 6-ft. are given by the Earl of Rosse in the sufficiently terse "cl."

Observing with my 9-inch "With-Browning," and powers 212 and 320, on the 14th of Oct. 1868, I detected a dark patch in the brighter central part of the cluster. Every subsequent season enables me to give further particulars. There is a bright knot in the blaze towards its N. side which is probable H's "nipple." S. and a little *p*, the latter there is a black spot or vacancy, and there are fainter dark lanes leading outwards from this spot *p* and *f*—the latter the more prominent. This blaze is not clearly resolved, and the whole object is more difficult and requires better air than the Earl of Rosse's three lanes in 13 M. of Hercules.

The interesting question is suggested whether these peculiarities in the cluster last mentioned and the great Andromeda nebula have any connection with the deficiency in the red end of their spectra, and I should be gratified by hearing the result of a careful examination of the spectrum of 15 Mes., with a large aperture.

In August, last year, I carefully examined 92 M. Hercules, having a spectrum similar to that of its neighbour 13 M., and made the following notes: Brighter stars, and more compressed than 13 M., but all the blaze is resolved by glimpses. Looked for darker portions, but could get nothing certain. Sometimes thought there was a darker space on *f* side.

Will some of your readers, possessing equal and larger apertures, kindly scrutinise these two clusters, and give us the results?

I am, Sir, yours truly,
T. H. BUFFHAM.

Bonner's Road, Victoria Park:
Aug. 7, 1872.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN OCT., 1872.

By W. R. Birt, F.R.A.S., F.M.S.

The lists for May, July, and September, 1871, may be consulted for objects suitable for observation in October, 1872. On May 21, 1871, the the value of ☾ — ⊙ was 152°, 21′ (see Vol. ix. p. 128). On October 4, 1872, the value is 151° 46′·0. The May list may, therefore, be used for October 4. The value of ☾ — ⊙ on July 20, 1871, was 142° 24′·8 (see Vol. ix. p. 172); and on September 17, 1871, 138° 51′·1 (see Vol. ix. p. 217). On October 5, 1872, the value is 139° 27′·1. The two lists may, consequently, be used from October 5. Those observers who have recorded their observations will find it advantageous to compare them with those which they may make during the present month.

Tenth Zone of objects from North to South, 30° to 35° W. long.

Euctemon, Democritus, Mason, Grove (*a*), Daniell (*a*), Chacornac (*b*), Le Monnier,* Littrow, Maraldi,* Vitruvius, Censorinus, Isidorus, Fracastorius, Piccolomini, Stiborius, Hommel,* Schomberger (the west part).

The objects in this zone which are within 60° of the moon's west limb, in mean libration, may be looked for as early as the fifth day of the moon's age, October 7. If not in sun-light, on the 7th they are likely to be fine objects for study on the 8th; all the objects in the ten zones may be observed under the evening illumination after the full.

The labours of the Committee appointed by the British Association for discussing observations of lunar objects suspected of changes having terminated successfully, inasmuch as the solar influence in darkening the floor of the Crater Plato has been well-established, and numerical values assigned to the gradations of tint as the sun attains his greatest altitude, and also as he declines towards the horizon of Plato (see No. 112, pp. 95, 96), it becomes exceedingly important that observations of a similar character should not only be continued but extended. The Committee in its report, while alluding to the results of the discussion, among which may be mentioned changes in brightness of portions of the floor not referrible to solar altitudes, spoke of the desirability of telescopes of large aperture being employed in the further prosecution of this interesting and important branch of astronomical research, but did not recommend

(*a*) See list for January, 1872, note (*a*) on p. 27 of 109.

(*b*) The crater on the S.W. of Posidonius, named to commemorate the astronomical labours of Chacornac.

(*) The objects thus marked have not been mentioned in the monthly lists.

any immediate steps to be taken to ensure the carrying out of its suggestion, hoping that the Association would not overlook the enquiry in future years. Had the Committee in presenting its final report suggested to the Association an immediate course of action with the view of maintaining the interest hitherto manifested, it is not at all unlikely that it would have been re-appointed. As this has not been done the subject of lunar research is for the present left entirely in private hands, and there is much room for exertion during the next year in obtaining materials for confirming and elucidating the results arrived at by the Committee. The region S.S.E. of the Mare Serenitatis, containing several dark spots; among them Julius Cæsar and Boscovech are very suitable for observations of the kind discussed by the Committee.

There is an error in the article "British Association and Lunar Work." The Lunar Committee was re-appointed in 1868, but not in 1869. It was in 1870 that the Committee for discussing observations of objects suspected of change was appointed.

Rhœticus.—Several new objects having been detected on the N.W. of this spot, especial attention is directed to it and the rugged region surrounding it. The "fault" which has dislocated its W. and N. borders, extending to the west of Albategnius on the S.S.W., and to Ukert or beyond, as far as the Apennines on the N.N.E., is an interesting study under an early illumination.

Erratum.—No. 106, October, 1871, p. 240, October 18, for *Bohnenbeger* read *Bohnenberger.*

THE PLANETS FOR OCTOBER.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m
Mercury ...	1st	12 7 35	+ 1 7½	5″·0	23 21·7
	15th	13 29 55	— 8 40	4″·8	23 54·8
Venus ...	1st	13 50 11	—10 51½	10″·6	1 7·9
	15th	14 56 59	—17 0	11″·0	1 19·5
Jupiter ...	19th	9 56 27	+13 21	32″·0	20 0·1
Saturn ...	1st	19 4 10	—22 32½	15″·2	6 21·0
	15th	19 6 9	—22 30½	14″·8	5 28·0
Neptune ...	3rd	1 36 21	+ 8 21		12 44·3
	15th	1 35 7	+ 8 1		11 55·0

Mercury is badly situated for observation.

Venus will be fairly observed towards the end of the month, setting an hour after the sun.

Jupiter may be well observed through the greater part of the night, rising shortly after midnight.

Saturn is still visible for about four hours after sunset, but very low.

Neptune is well situated for observation.

ASTRONOMICAL OCCURRENCES FOR OCTOBER, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn.
Tues	1	 6 50	Sidereal Time at Mean Noon, 12h. 42m. 5·95s. Conjunction of Moon and Mercury, 3° 5′ S.	1st Oc. R.	16 36	6 21·0
Wed	2	3 30	● New Moon Sun's Meridian Passage, 10m. 48·49s. before Mean Noon	1st Tr. E.	13 45	6 17·2
Thur	3	21 0	Conjunction of Moon and Venus, 2° 34′ S. Saturn's Ring: Major Axis=37″·90 Minor Axis=15″·89			6 13·4
Fri	4			2nd Sh. I.	17 6	6 9·5
Sat	5	18 31	Conjunction of Mars and *α* Leonis (10·2m.), W.			6 5·7
Sun	6			2nd Oc. R.	16 10	6 1·9
Mon	7			3rd Ec. R. 3rd Oc. D. 1st Sh. I.	15 51 22 16 12 17 54	5 58·1
Tues	8			1st Ec. D.	15 16 59	Moon. 4 51·5
Wed	9	9 3 5 14	☽ Moon's First Quarter Conjunction of Moon and Saturn 3° 25′ N.	1st Tr. I. 1st Sh. E. 1st Tr. E.	13 23 14 43 15 43	4 52·2
Thur	10			4th Tr. E.	16 22	6 52·9
Fri	11	9 20 9 29 10 26 10 48	Conjunction of Venus and *α* Libræ (4·6m.), E. Near approach of 33 Capricorni (5½) Occultation of 35 Capricorni (6) Reappearance of ditto			7 51·7
Sat	12	17 57	Superior conjunction of Mercury			8 47·5
Sun	13			2nd Ec. D.	13 53 51	9 40·2
Mon	14	5 52 6 53 9 4	Occultation of 33 Piscium (5) Reappearance of ditto Near approach of B.A.C. 17 (6)	3rd Ec. D.	16 16 7	10 30·3
Tues	15	 10 21 13 9 14 45	Illuminated portion of disc of Venus = 0·913 Illuminated portion of disc of Mars = 0·950 Near approach of 26 Ceti (6½) Near approach of 29 Ceti (6½) Near approach of 33 Ceti (6)	2nd Tr. E. 1st Ec. D.	14 2 17 10 21	11 18·9

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Wed	16	3 34	○ Full Moon	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	14 16 15 21 16 37 17 41	12 7·0
Thur	17	 11 14 5 54	Sidereal Time at Mean Noon, 13h. 45m. 10·80s. Opposition of Neptune and Sun Near approach of 31 Arietis (6)	1st Oc. R.	15 2	Moon. — 12 55·4
Fri	18	8 32	Near approach of B.A.C. 1096 (5½)	3rd Tr. E. 4th Ec. R.	14 7 17 2 7	13 44·9
Sat	19	8 55	Near approach of B.A.C. 1373 (6)			α Pegasi 9 4·9
Sun	20			2nd Ec. D.	16 28 59	9 0·9
Mon	21					8 57·0
Tues	22	10 56 15 18 16 0	Near approach of 52 Geminorum (6) Occultation of A Geminorum (5½) Reappearance of ditto	2nd Tr. I. 2nd Sh. E. 2nd Tr. E.	13 49 14 27 16 44	8 53·0
Wed	23	20 53	☾ Moon's Last Quarter Saturn's Ring : Major axis = 36″·68 Miuor axis = 15″·28	1st Sh. I. 1st Tr. I. 1st Sh. E.	16 10 17 18 18 20	8 49·1
Thur	24	4 0	Conjunction of Moon and Uranus 4° 6′ S.	1st Ec. D. 1st Oc. R.	13 31 54 16 58	8 45·2
Fri	25	22 41	Conjunction of Moon and Jupiter, 4° 40′ S.	1st Sh. E. 3rd Sh. E. 1st Tr. E. 3rd Tr. I. 3rd Tr. E.	12 59 13 40 14 7 14 37 18 19	8 41·2
Sat	26	2 10 6 0 15 46	Conjunction of Mars and χ Leonis, 0° 8′ S. Conjunction of Jupiter and ν Leonis, (8·5m.) W. Conjunction of Mars and χ Leonis, (1·2m.) W.			8 37·3
Sun	27	6 14	Conjunction of Moon and Mars, 4° 0′ S.			8 33·4
Mon	28					8 29·4
Tues	29			2nd Sh. I. 2nd Tr. I. 2nd Sh. E.	14 5 16 30 17 1	8 25·5
Wed	30			1st Sh. I.	18 3	8 21·6
Thur	31	17 28	● New Moon	2nd Oc. R. 1st Ec. D. 1st Oc. R.	13 40 15 25 6 18 55	8 17·6
NO Fri	V. 1	10 8	Conjunction of Mars and σ Leonis (2·1m.), E. Conjunction of Moon and Mercury 2° 25′ S.	1st Sh. I. 1st Tr. I. 3rd Sh. I. 1st Sh. E. 3nd Sh. E. 3 Tr. I.	12 32 13 44 13 55 16 4 17 38 18 46	8 13·7

SUN.

Greenwich, Noon. 1872.	Heliographical western longitude of the centre of the sun's disc.		Heliographical latitude of the centre of the sun's disc.	Angle of position of the sun's axis.
	°		°	°
Oct. 1	282·02	13·21	+6·59	26·26
2	295·23	13·21	6·53	26·31
3	308·44	13·21	6·48	26·36
4	321·65	13·21	6·22	26·40
5	334·86	13·21	6·36	26·44
—				
6	348·07	13·21	+6·30	26·47
7	1·28	13·20	6·24	26·49
8	14·48	13·21	6·17	26·50
9	27·69	13·21	6·11	26·50
10	40·90	13·20	6·04	26·50
11	54·10	13·21	5·97	26·49
12	67·31	13·21	5·90	26·48
—				
13	80·52	13·20	+5·82	26·45
14	93·72	13·21	5·75	26·42
15	106·93	13·21	5·67	26·38
16	120·14	13·20	5·59	26·33
17	133·34	13·21	5·51	26·28
18	16·55	13·20	5·43	26·22
19	159·75	13·21	5·34	26·15
—				
20	172·96	13·20	+5·26	26·07
21	186·16	13·20	5·17	25·98
22	199·36	13·21	4·99	25·89
23	212·57	13·20	4·99	25·79
24	225·77	13·20	4·90	25·68
25	238·97	13·20	4·80	25·56
26	252·17	13·21	4·71	25·43
—				
27	265·38	13·20	4·61	25·30
28	278·58	13·20	4·51	25·16
29	291·78	13·20	4·41	25·01
30	304·98	13·20	4·31	24·86
31	318·18	13·20	4·21	24·69
Nov. 1	331·38		4·11	24·52

Assumed daily rate of rotation, 14°·20.

MOON.

12h. Greenwich mean time. 1872.	LIBRATION. Selenographical colong. and lat. of the point on the moon's surface which has the *Earth's* centre in the zenith. colong.	lat.	SUN'S PLACE. *Sun's* centre in the zenith. colong.	lat.	TERMINATOR. Selenographical colong. of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets. 60° N.	0°	60° S.
	°	°	°	°	°	°	°
						SUNRISE.	
Oct. 9	92·45	+4·61	4·10	+1·17	96·1	94·1	92·1
10	91·40	5·67	16·28	1·15	108·3	106·3	104·3
11	90·21	6·37	28·45	1·13	120·4	118·5	116·5
12	88·93	6·67	40·61	1·11	132·5	130·6	128·7
—							

13	87·64	+6·55	52·77	+1·09	144·6	142·8	140·9
14	86·43	6·01	64·93	1·07	156·8	154·9	153·1
15	85·40	5·12	77·08	1·05	168·9	167·1	165·3
16	84·67	3·93	89·23	1 02	SUNSET.		
17	84·27	2·54	101·37	1·00	9·6	11·4	13·1
18	84·25	+1·04	113·53	0·97	21·8	23·5	25·2
19	84·59	—0·47	125·69	0·95	34·0	35·7	37·3
—							
20	85·26	—1·92	137·85	+0·92	46·2	47·9	49·5
21	86·20	3·25	150·01	0·90	58·4	60·0	61·6
22	87·35	4·41	162·18	0·87	70·7	72·2	73·7
23	88·61	5·37	174·35	0·85	82·9	84·4	85·8
·24	89·92	6·10	186·53	0 82	95·1	96·5	98·0
25	91·18	6·56	198·72	0·80	107·3	108·7	110 1
26	92·33	6·71	210·91	0·77	119·5	120·9	122·3
—							
27	93·30	—6·63	223·10	+0·75	131·8	133·1	134·4

Colong. $= 90° - \lambda$.

The express object, for which a well marked fundamental point near the middle of the moon's disk is required, is a twofold one.

If a very detailed lunar map on a large scale is to be constructed on really scientific principles, there can be no question but that it must be preceded by and founded upon a correct survey of a great many of the leading points of the moon's disk. Maedler's points of the first order are not only too few and far between, but their accuracy, while perhaps sufficient for his own work, can scarcely be considered great enough for a much enlarged map. Now, in a new undertaking of the kind, instead of following the method adopted by Lohrmann and Maedler, for determining selenographical positions, a far more practical and effective plan (at least in the writer's opinion) will be, to observe the apparent positions of the leading points directly in reference to some common zero-point near the middle of the disk, and to get the selenographical cöordinates of the latter by making it the point of observation in a special investigation of the moon's librations. If by following this plan, the deduction of the cöordinates of the leading points from their observed positions become somewhat more complicated, the observations themselves are made with so much more ease and certainty, and freedom from several sources of error, that the results must needs be of superior accuracy. Now, which is the best zero-point? How does Moesting A (the point O of Schlueter's and Wickmann's observations) or Triesnecker B, or some other point in the neighbourhood, appear in the original negatives of lunar photographs?

The second purpose for which a well-marked point near the middle of the moon's disk is required, is that of being employed in meridional and altazimuth observations of the moon's place in the heavens. The writer does not know how far Maedler's old suggestion has been acted upon in some of the operations of the U. S. Coast Survey, for determining differences of terrestrial longitudes. It is to be hoped that it will be acted upon in the observations for settling the longitudes of the distant stations, where the transit of Venus is to be observed. But which is the best spot for the purpose? When does the shadow within Moesting A cease to be a difficulty, or begin to be one? Instead of asking such questions the writer would prefer to settle them, but he has not had the opportunities for doing so.

The monthly tables for sun and moon are computed with the help of auxiliary tables, which may be published at some convenient occasion before long. The formulæ for libration and others will then probably be found preferable to those hitherto known. In the numbers given above all sensible terms are taken into account.

MINIMA OF ALGOL.

	1872. Oct.	13.	15·4h.	G.M.T.
		16.	12 2	„
Hour and fraction.		19.	9·0	„

The following minor planets come into opposition during October :—

1872.				Mag. m.	A.R. h. m.	P.D. °
Oct. 2	Arethusa	(95)	...	10·5	0 46	68·2
9	Amphitrite	(29)	...	8·8	0 56	80·0
11	Europa	(52)	...	10·5	1 22	92·5
14	Angelina	(64)	...	10·6	1 16	79·8
15	Lactitia	(39)	...	8·2	1 42	92·7
28	Aglaja	(47)	...	11·3	2 15	72·1
28	Artemis	(105)	...	12·7	2 31	91·9
29	Minerva	(93)	...	11·2	2 8	69·8
31	Hecuba	(108)	...	11·9	2 22	71·1

Sweeping Ephemerides for the Comet of Biela, including the Period of Absence of Moonlight in the Morning Sky in October.

1872. 9h. 36m.	Perihelion, Sept. 91·4.		Perihelion, Oct. 6·4			Perihelion, Oct. 14·4	
G.M.T.	R.A.	Decl.	R.A.	Decl.	Δ	R.A.	Decl.
	h. m.	° ′	h. m.	° ′		h. m.	° ′
Sept. 28	10 4·0	+6 27	9 43·0	+9 15	1·345	9 20·3	+12 22
30	13·0	5 21	9 52·4	8 6		30·2	11 9
Oct. 2	21·9	4 15	10 1·7	6 56	1·365	40·0	9 56
4	30·7	3 9	10·9	5 46		49·7	8 42
6	39·3	2 4	19·9	4 37	1·388	9 59·2	7 28
8	47·8	+1 0	28·8	3 28		10 8·6	6 15
10	10 56·2	−0 3	37·6	2 20	1·414	17·8	5 2
12	11 4·5	1 4	46·2	1 13		26·9	3 50
14	12·6	2 5	10 54·8	+0 7	1·442	35·8	2 38
16	20·6	3 4	11 3·2	−0 58		44·6	1 27
18	11 28·5	−4 2	11 11·4	−2 2	1·472	10 53·3	+0 18

Mr. Bishop's Observatory,
Twickenham : Sept. 17, 1872.

J. R. HIND.

ANCIENT ECLIPSES.—Our readers will be glad to hear that Mr. Hind is preparing a work with the details of a long series of calculations on the historical and other eclipses.

WE are obliged to postpone our list of subscriptions received, and some interesting articles, for want of space.

Erratum. Page 222, line 6, for *Foxteth* read *Toxteth.*

Book received.—"Eighth Report of the Board of Visitors to the Observatory at Victoria." John Ferres, Melbourne.

TO CORRESPONDENTS.

NOTICE.—It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 119. NOVEMBER. 1872.

ASTRONOMICAL ALLUSIONS IN HOMER, DANTE, SHAKESPEARE AND MILTON.

By G. J. Walker.

III.—Shakespeare.

Though an acquaintance with law, medicine, divinity, history, politics, geography, and general literature has been ascribed to Shakespeare, we should not expect to find in this greatest of uninspired writers much more in the way of astronomical allusions than images and figures derived from the heavenly bodies. But what Schlegel* remarks of the images in general of Shakespeare, certainly holds good in regard to those of a *celestial* character: that "in their unsought, nay uncapricious singularity, they have a sweetness altogether peculiar." A few passages will be cited at length, and references given to others.

The Moon.—The moon is chiefly alluded to in connexion with her influence on the tides. Thus she is called "watery," Midsummer Night's Dream, act ii., scene 2, King Richard III., act ii., scene 2; "the governess of floods," Midsummer Night's Dream, act ii., scene 2. See also Winter's Tale, act i., scene 2, King Lear, scene v., act 3; 1 Henry IV., act i., scene 2, Hamlet, act i., scene 1. She is the cause of madness:—

> "It is the very error of the moon;
> She comes more near the earth than she was wont,
> And makes men mad."—Othello act v., scene 2.

And of rheumatic diseases, Midsummer Night's Dream, act ii., scene 2.

The pretty picture of a bright moon-light night will be remembered in the Merchant of Venice:—

> "How sweet the moonlight sleeps upon this bank!
> Here will we sit, and let the sounds of music
> Creep in our ears; soft stillness, and the night
> Become the touches of sweet harmony.

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* *Lectures on Dramatic Literature.*

Sit, Jessica: Look, how the floor of heaven
Is thick inlaid with patins of bright gold;
There's not the smallest orb which thou behold'st,
But in his motion like an angel sings,
Still quiring to the young-eyed cherubims:
Such harmony is in immortal souls;
But, whilst this muddy vesture of decay
Doth grossly close it in, we cannot hear it."—Act v., scene 1.

Stars.—Cæsar is made to refer to the polar star as an emblem of his own constancy and immovable resolve:—

"But I am constant as the northern star,
Of whose true fix'd and resting quality,
There is no fellow in the firmament.
The skies are painted with unnumber'd sparks,
They are all fire, and everyone doth shine;
But there's but one in all doth hold his place."
Julius Cæsar, act iii., scene 1.

We must not be too critical here; for in the time of Cæsar the pole had moved a long way from κ Draconis, and was still further from reaching our present polar star, the which no doubt Shakespeare had in view; and to which allusion is made again in Othello, in the description of the storm on the coast of Cyprus:—

"The chiding billow seems to pelt the clouds;
The wind-shaked surge, with high and monstrous main,
Seems to cast water on the burning Bear,
And quench the guards of the ever-fixed pole."
—Act ii., scene 1.

Juliet's eyes were brighter than the brightest stars:—

"Two of the fairest stars in all the heaven,
Having some business, do entreat her eyes
To twinkle in their spheres till they return.
What if her eyes were there, they in her head?
The brightness of her cheek would shame those stars,
As daylight doth a lamp; her eye in heaven
Would through the airy region stream so bright,
That birds would sing, and think it were not night."
Romeo and Juliet, act ii., scene 2.

And Juliet says of her lover:—

"Give me my Romeo; and, when he shall die,
Take him and cut him out in little stars,
And he will make the face of heaven so fine,
That all the world shall be in love with night,
And pay no worship to the garish sun."—Id., act iii., scene 2.

Compare Cymbeline, act v., scene 2..—

———"They are worthy
To inlay heaven with stars."

The stars are called "Diana's waiting women," Troilus and Cressida, act v., scene 2. Their supposed rule over the destinies of individuals is often alluded to: 1 Henry VI., act i., scene 1; 3 Henry VI., act iv., scene 6; King Lear, act iv., scene 3; Romeo and Juliet, act v., scene 3; Julius Cæsar, act i., scene 2; Locrine, act i., scenes 1, 2; act iii., scenes 2, 6; as also are planetary influences: Cymbeline, act v., scene 4.; King Lear, act i., scene 1; Hamlet, act i., scene 1; Othello, act ii., scene 3; Troilus and Cressida, act i., scene 3; Locrine, act i., scene 2; 1 Henry VI., act i., scene 1; 2 Henry VI., act iv., scene 4. But notwithstanding this belief in the influence of stars and planets, which could not fail to appear frequently in the dramas without of necessity reflecting the poet's own opinion, the latter may perhaps be inferred from such passages as the following: "This is the excellent foppery of the world! that, when we are sick in fortune (often the surfeit of our own behaviour), we make guilty of our disasters, the sun, the moon, and the stars: as if we were villains by necessity, fools by heavenly compulsion; knaves, thieves, and treachers, by spherical predominance; drunkards, liars, and adulterers, by an enforced obedience of planetary influence; and, all that we are evil in, by a divine thrusting on:" . . . The rest of the passage is equally witty, but scarcely suited for public reading now. King Lear, act i., scene 2.

"Our remedies oft in ourselves do lie,
Which we ascribe to heaven: the fated sky
Gives us free scope; only, doth backward pull
Our slow designs, when we ourselves are dull."
All's well that ends well, act i., scene 1.

Remembering, however, that even Shakespeare's great contemporary Kepler was imbued with the superstition of astrology, it would not be surprising if the poet did not escape it.

Celestial Prodigies.—In Hamlet those preceding the death of Cæsar are thus described:—

——"Stars with trains of fire and dews of blood,
Disasters in the sun; and the moist star,
Upon whose influence Neptune's empire stands,
Was sick almost to Doomsday with eclipse."—Act i., scene 1.

See also King Lear, act i., scene 2 (eclipses); Locrine, act v., scene 4.

It may be that a glimpse of Shakespeare's own view appears in the following in King John:—

"No natural exhalation in the sky
No scope of nature, no distemper'd day,
No common wind, no customed event,
But they will pluck away his natural cause,
And call them meteors, prodigies, and signs,
Abortives, presages, and tongues of heaven,
Plainly denouncing vengeance upon John."
—Act iii., scene 4.

Comets.—Calphurnia, Cæsar's wife, says:—

"When beggars die, there are no comets seen;
The heavens themselves blaze forth the death of princes."
Julius Cæsar, act ii., scene 2.

And the Duke of Bedford in the first part of King Henry VI., act i., scene 1, exclaims:—

"Hung be the heavens with black, yield day to night!
Comets, importing change of times and states,
Brandish your crystal tresses in the sky;
And with them scourge the bad revolting stars,
That have consented unto Henry's death!"

See also 1 Henry IV., act iii., scene 2.

Venus.—The evening star is alluded to, Sonnet cxxxii.:—

"Nor that full star that ushers in the even
Doth half that glory to the sober west,
As those two mourning eyes become thy face."

Meteors.—Meteors are supposed to be exhalations from the earth; and regarded as portents: "My lord, do you see these meteors? Do you behold these exhalations?" 1 Henry IV., act ii., scene 4; see also act v., scene 1. Romeo and Juliet, act iii., scene 5. Cardinal Wolsey in prospect of his disgrace, says:—

———"I shall fall
Like a bright exhalation in the evening,
And no man see me more."—Henry VIII., act iii., scene 2.

They are conceived to be drawn from the sky by music:

"And certain stars shot madly from their spheres,
To hear the sea-maid's music."
—Midsummer Night's Dream, act ii., scene 2.

At the destruction of Troy, as it were the mirror of their brightness,

———"The skies were sorry,
And little stars shot from their fixed places,
When their glass fell wherein they viewed their faces."
Rape of Lucrece, towards the end.

See also 1 Henry IV., act i., scene 1; Venus and Adonis, stanza 138. The following passages might seem to be grounded on some brilliant display, as of the November meteors in late years. In King John, the Dauphin, Lewis, says of the tears of Salisbury:—

"This shower . . .
. . . Makes me more amazed
Than I had seen the vaulty top of heaven
Figured quite o'er with burning meteors."—Act v. sc. 2.

In the first part of Henry IV., Glendower says:—

———"At my nativity,
The front of heaven was full of fiery shapes,
Of burning cressets.* . . .
. . . The heavens were all on fire."—Act iii., scene 1.

In King Richard II.:—

——"Meteors fright the fixed stars of heaven:
The pale-faced moon looks bloody on the earth."—Act ii., scene 4.

Locrine speaks of

"Mighty Jove, the supreme king of heaven,
That guides the concourse of the meteors,
And rules the motion of the azure sky."—Act iv., scene 1.

The last passage to be produced from Shakespeare is from Love's Labour Lost, where Biron speaks thus disparagingly of astronomers:—

"These earthly godfathers of heaven's lights,
That give a name to every fixed star,
Have no more profit of their shining nights,
Than those that walk, and wot not what they are."
—Act i., scene 1.

He may be forgiven this, however, in consideration of the splendid eulogy on women, which he afterwards delivered—a subject on which he was more at home. True it is, nevertheless, that we could have dispensed with some of the work of these modern "godfathers"; and our globes and star-maps would be none the worse for ceasing to exhibit so many memorials of their officiousness and bad taste.

"*SPOTS IN THE SUN.*"

To the Editor of the *Times*.

Sir,—Among the astronomical observations upon record which have not as yet received a satisfactory explanation are those relating to spots upon the sun's disc, which have traversed it much more rapidly than the ordinary solar spots. In several cases these quickly-moving spots are described as round, black, and sharply defined, like the planet Mercury, in transit, and hence the suspicion has arisen that one or more planetary bodies are revolving round the sun within the orbit of Mercury. M. Le Verrier, from theoretical considerations founded upon an unexplained motion in the line of apsides of this planet's orbit, has inferred the existence of a zone of asteroidal bodies within it.

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* *I.e.* Lights.

I have lately examined these observations with the immediate object of ascertaining whether it were possible to obtain a clue, however rough, that might lead to a rediscovery—on the supposition that an unknown planet exists at no great distance from the sun. In more than one instance the observations appear to refer rather to a comet than to a planetary body, and the bright comet of 1819 would seem to have been remarked in its passage over the sun's disc at the end of June by Canon Stark at Augsberg, and probably by Pastorff, near Dresden (though his observation is confused). But, on the other hand, it appears highly improbable that a comet projected upon the sun's disc would present the round, well-defined figure which several observers have noted, and particularly so that it would appear black like the planet Mercury when passing over the sun. It is incredible that so many persons can have been deceived as to the rapid motion of these suspicious objects, and the only conclusion that we can arrive at, unless the observations are altogether rejected (quite an inadmissible proceeding), appears to be that we have not yet brought into harness all the inferior planets that exist.

In the course of my enquiry I have only met with one instance wherein there appears any ground for a prediction which might possibly lead to the recovery of the object to which the observations relate. Small, black, circular, well-defined bodies are reported to have been upon the sun's disc, by Dr. Lescarbault, at Orgeres, in France, on March 26, 1859, and by Mr. Lummis, at Manchester, on March 20, 1862, and it is a suspicious circumstance that the elements as regards the place of the node, or point of intersection of the orbit with the ecliptic, and its inclination thereto, as worked out by M. Valz, of Marseilles, from the data I deduced from a diagram forwarded to me by Mr. Lummis, are strikingly similar to those founded by M. Le Verrier upon the observations, such as they were, of Dr. Lescarbault. It is true if the place of the node and inclination were precisely as given by this astronomer, the object which was seen upon the sun's disc on the 26th of March could not have been projected upon it as early as the 20th of March. But, considering the exceedingly rough nature of the observations upon which he had to rely, perhaps no stress need be placed upon the circumstance. Now the period of revolution assigned by M. Le Verrier from the observations of 1859 was 19·70 days. Taking this as an approximate value of the true period, I find, if we suppose 57 revolutions to have been performed between the observations of Dr. Lescarbault and Mr. Lummis, there would result a period of 19·81 days. On comparing this value with the previous observations in March and in October, when the same object might have transited the sun at the opposite node, it is found to lead to October 9, 1819, as one of the dates when the hypothetical planet should have been in conjunction with the sun. And on this very day Canon Stark has recorded the following notable observation :—"At this time there appeared a black, well-defined nuclear spot, quite circular in form, and as large as Mercury. This spot was no more to be seen at 4.37 p.m., and I found no trace of it later on the 9th, nor on the 12th, when the sun came out again." The exact time of this observation is not mentioned, but appears likely to have been about noon, one of Stark's usual hours for examining the solar disc. Hence I deduce a corrected period of 19·812 days. If such a planetary body exists, on the supposition that it was remarked upon the sun in 1819, 1859, and 1862, this period would probably not be much in error; and if we suppose the orbit to be circular or nearly so, with the approximate knowledge we have of the place of the node and inclination of the orbit, we may venture upon a prediction of the times of the greatest elongations from the sun eastward and westward, and the positions of the hypothetical body at the times. I have before me places so calculated for the times of the greatest elongations during the next few months, upon which it is proposed to institute a search at this Observatory, using the same means by which we succeeded in bringing out the first comet of 1847 near its perihelion, at noon-day, and less than three degrees from the sun's limb. I refrain, however, from giving publicity to these predictions, in the fear of causing a number of observers to lose much time in searching for a body, which may have no existence except in my own imagination.

I will, nevertheless, suggest that on the 24th of March next a very close watch must be kept upon the sun's disc. With the period I have inferred a conjunction with the sun would occur about 10 a.m. on that day, but it will be desirable to extend the period of observation through the whole 24 hours, and on this account the aid of observers on distant meridians will be important. If the hypothetical body is not found upon the sun's disc at that time, it will be, I think, a sufficient proof that my surmises are incorrect.

In the circumstances I have here described consists the only clue I have been able to discover to a possible recovery of one of these supposed planetary bodies. It is obvious that the object seen upon the sun in March cannot, with its apparent inclination of orbit, be identical with that seen near Midsummer, 1847, in the metropolis by Mr. Scott, the Chamberlain of London, and at Whitby by Mr. Wray, the eminent optician, nor yet that remarked by M. Coumbary at Constantinople in May, 1865. I am, Sir, your obedient servant,

Mr. Bishop's Observatory, Twickenham : J. R. HIND.
October 18.

NOTES ON THE WONDERS AND BEAUTIES OF THE STARRY HEAVENS.

By C. Grover, Assistant to John Browning, Esq., F.R.A.S.

No. 5.—The Annular Nebula in Lyra.

About 6° south of Vega, and a little to the left when on the meridian, are two tolerably bright stars rather more than 2° asunder. The preceding and more elevated star is β, the following one is γ; and, though both are marked third magnitude on the maps of the S.D.U.K., β is a well-known variable, and γ is strongly suspected of the same peculiarity. Of this we may have more to say hereafter; for the present we only refer to them as pointers to an object well-worthy to take rank as one of the most noteworthy of the celestial wonders. A little south of the line joining these two stars, and nearer β than γ, a small telescope enables us to discover a minute roundish nebula. I have thus seen it tolerably well-defined and very like a planetary nebula in a 2-inch achromatic. With a 4½-inch silvered glass speculum the elliptical figure and central opening are distinctly visible, with a 6½-inch speculum it gains in beauty and interest, the faint illumination of the interior and the irregularities of the outer margin are just perceptible. Even with this small aperture the light is evidently mottled and distinctly different from the milky nebulosity of the great nebulæ in Andromeda and Orion. In the 12¼-inch speculum many details of great interest become visible. The faint nebulosity of the interior is seen to be crossed by four brighter streaks lying in the direction of the longer axis; three of these are about equal in distinctness, but the second streak from the preceding internal edge of the ring is obviously the brightest. When best seen, these details always leave the impression on my mind of being more remote than the ring itself, and this idea is supported by the fact that four or five faint filaments or streams of light are seen extending from both ends of the ellipse as if they were continuations of those within its interior, thus leading to the supposition that the bright ring which is alone visible in small instruments, is seen projected a still more remote, stratified nebulosity; and this opinion is strengthened by the fact that although there are several irregularities about the exterior of the ring's minor axis, they are very faint and unimportant compared with those which appear to traverse the interior and extend beyond either end.

The ring itself when seen with a low power and large aperture exhibits a surprising degree of brilliancy; indeed, when the power is insufficient to reveal the figure of a nebula, it might easily be confounded with some of the tolerably bright stars which appear with it in the same low power field, and with moderate powers its brightness is such, especially about the extremities of the minor axis of the ellipse, as to give a false impression of resolution. Indeed, it has been announced as resolved into stars by several observers of considerable eminence in observational astronomy. These observations, however, are in direct contradiction to the evidence of the spectroscope, which in the hands of an observer worthy of equal confidence, has distinctly shown this object to have a gaseous constitution. Notwithstanding this, I was strongly inclined, from its exceptional brightness and mottled appearance in the smaller instruments I had previously employed, to believe in its stellar composition, and I had great hopes that the power of the 12¼-inch speculum would reveal the "star dust" described by other observers. I have therefore on several occasions, scrutinised the nebula when the absence of the moon, a clear sky, and its position on or near the meridian, allowed it to be seen to great advantage, at such times being steadily kept in view by the equable movement of the equatorial clock, it presented a superb spectacle. But with the utmost care and attention, and the application of considerable magnifying powers, I could never detect the least indications of a stellar composition, it simply appeared as nebulous as ever. I do not percieve with this aperture any appearance of the fluctuation of light or twinkling appearance which has been described by some observers, and which would seem to be caused by insufficient optical power, as I have sometimes noticed an unsteady appearance when using a small speculum; an analagous phenomenon is perceived when observing a star so minute as to be only just within the power of the aperture in use, which will appear fluctuating or seen by glimpses. With this every observer is familiar.

A small star follows the nebula on an angle of 96°, and at a distance of rather more than the breadth of the ring as determined by Sir J. Herschel, he gives it eleventh magnitude, but it appears to me, as it does to several observers, much smaller. I find it but just steadily visible in a 6½-inch speculum. This star, which is shown in most of the copies of Sir John's drawing to be found in every recent astronomical work, has been suggested as a convenient fixed point from which to obtain a set of micrometrical measures of the internal and external dimensions and positions of the centre of the nebula, so as to afford a ready means of detecting any changes of form, size, or position, which might hereafter take place. This very desirable information is not, however, so easy to be obtained, many serious practical obstacles standing in the way of its accomplishment. For instance, the small instruments which give the best outline of the nebula scarcely show the star, and with larger apertures the star is of course well seen, but the outline of the nebula becomes more and more irregular with increasing powers, and again the illumination of the field necessary to render the micrometer webs visible seriously interferes with the distinct perception of so delicate an object. There are four other much smaller stars nearer the nebula than the one just mentioned, one of these lies at a rather less distance from the opposite edge of the ring, two others forming a neat pair are very near its northern margin, and another about as near the southern edge; these very delicate objects are visible with a power of 300 on the 12½-inch speculum.

The Annular Nebula in Lyra is by far the largest and most conspicuous representative of this not very numerous class of objects. Two other examples, figured by Sir John Herschel in his "Cape Observations," are well worthy of notice as exhibiting the different appearances we might expect in such objects, arising either from increased distance smaller dimensions, or inferior optical power. One of these is situated is R. A., 17h. 19m., and 23° 37′ south declination, and is therefore a little north of the centre of a line joining the two fifth-magnitude stars 44 and 50 in Ophiuchus. It is described as "exactly round, pretty faint, 12″ in diameter, well terminated, very little cottony at the edge, with a decided darkness in the middle, few stars in the field, a beautiful specimen of the planetary annular class of nebulæ." Any observer who has seen the nebula in Lyra with a small telescope, will at once perceive that, as regards the general appearance, this is an exact description of that object. The other example has R. A., 17h. 10m., and south declination, 38° 18′, and therefore only barely rises above our horizon; it is described as "a delicate, extremely faint, but perfectly well-defined annulus, 15′ 20″ diameter, the field crowded with stars, two of which are on the nebula." These stars are shown in the figure at the opposite sides of the minor axis, and therefore coincide with the brightest parts of the ring of the nebula in Lyra. "The interior, indeed, appears to be devoid of any illumination, but the object is so faint that a nebulosity filling in the centre and bearing no greater proportion in respect of density to the ring, than in the case of 57 M., could not be perceived."

It is worthy of remark, as showing how little many book illustrations resemble the objects intended, that in "Guillemin's Heavens," 2nd edition, page 335, both these objects are engraved, the former with a perfectly black centre, and the latter with an interior distinctly nebulous, in direct contradiction to the figures and descriptions of Sir John Herschel.

In the "Cape Observations," he remarks, "it is not impossible that the real constitution of these bodies may be that of hollow spherical or elliptical shells, of which the borders appear brighter than the interior by reason of the greater thickness of the luminous matter, or starry stratum, traversed by the visual ray." The tenuity of the ring, as well as the feebleness of the central illumination, will of course in our hypothesis be proportioned to the thinness of the shell; and the law of the degradation of its light will be determined by the ratio of the radii of its inner and outer surfaces, as well as by the law of density of the strata of which it consists.

The thoughtful reader will not be slow to perceive that, though this hypothesis perfectly explains the regular outline of the nebula in Lyra as seen in the 18-inch reflector, the streaks in its interior, and the numerous filaments extending from its circumference more recently observed, point to a more complicated constitution, and render this hypothesis somewhat unsatisfactory. Moreover, it is not improbable that a re-examination of other objects of this class with superior optical means, may lead, as we have seen to be the case with other nebulæ, to very different views of their constitution to those now entertained.

ASTRONOMY IN CENTRAL ASIA.

That a considerable amount of astronomical knowledge may be, and has been, acquired by different tribes living in Central Asia is generally admitted; and Col. Chesney has given a curious account, extracted from a work published at Paris in 1840, of a primitive people of the present day, who wander with their flocks over the vast steppes of Central Asia. The Kioghis-Kazak tribe have preserved a certain knowledge of astronomy, handing it down from father to son. Living in the open air, under the shade of a rock, a cave, or a tent, they watch the motion of the sun by day, and the revolution of the heavens by night. Like the earliest Chaldeans and Egyptians, they have no other means of measuring time than those afforded by the sun, moon, and stars; and they distribute their days by the sun, as a European does by his watch. Like their prototypes, the Chaldeans, they, too, have a system of astrology, in accordance with the rude principles of which they people the heavens with good and evil spirits, who preside over the days of the year, and to whose influence they suppose all living things to be subject. The names of the constellations have a curious connection with the wants and habits of the people themselves. Thus they call the North Pole, which, as the directing point, occupies the first place in their heavens, the iron stake; Venus bears that of "The Shepherd," as rising when the cattle are brought home or taken out to pasture; the Great Bear they compare to seven wolves following a grey and white gelding; the Pleiades to wild sheep, and when absent, supposed to be bringing grass to the terrestrial sheep; and the Milky-way is called the road of the birds emigrating from north to south. (Alexis de Leochine: *Description des Hordes, etc., Kioghis-Kazaks trad. du Russe, Paris,* 1840).

Vaux: *Nineveh and Persepolis,* pp. 51, 52.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

TESTS FOR THE TELESCOPE.

Sir,—Many amateurs of small experience conclude, unreasonably, that their telescopes are at fault, because they cannot make out the tests mentioned in books. Their instruments may, however, be excellent, but their vision not as yet sufficiently trained for that kind of work. It is a well-known fact that the eye is susceptible of education, and that practice will render visible faint objects whose very existence could not at first be as much as suspected. Many who do not perceive a minute star, after a few minutes of searching, give up further observation, and blame the telescope; but if they had persevered a little longer they would, in many cases, have been rewarded with success. It is essentially necessary to be in an easy position when using the telescope, for if the head and arms be shaking one need not expect to see any difficult object. The powers of vision are very different with different persons. Kepler informs us that his pupil Möstlin could perceive fourteen stars in the Pleiades, and a daughter of the present Astronomer-royal can see twelve in the same group. They are few in number who with the unassisted eye can see more than six. So it is with the telescope. One observer looking through a telescope will be able to see certain objects, and another looking through the same instrument, under similar circumstances of definition and atmosphere will not be able to perceive them. There are renowned observers, such as the late Mr. Dawes, in whose hands a small instrument was as efficient as a larger one in the hands of others. They published their success, and proposed tests to prove the merits of a telescope. These sharp-sighted observers were like eagles among astronomers, and the tests proposed by them might do very well if all telescopists were gifted with similar powers of vision. Dawes saw the companion to Polaris distinctly and steadily with an aperture of 1·6, and proposed that star as a test for a telescope of 2-inches. I think that those who see it with that aperture are not very numerous, and that it will require one of about 3-inches for a person of ordinary sight. When amateurs are trying their telescopes, they should remember that what astronomers call personal equation plays a very important part, and that they are apt to blame a good telescope for the peculiarities of their own vision. Some eyes are more sensitive to certain colours than to others, and some eyes are more easily dazzled by the light of large stars than others, in such a way that they cannot see minute points of light in their vicinity. Webb proposes the Comes to Polaris, as a test for small apertures above 2-inches, and in speaking of his $3\frac{7}{10}$ achromatic, he asserts that all it can do is to glimpse the companious of Vega and Aldebaran, Now, I have a telescope in which the visibility of these small stars is astonishingly easy, but with which I experience some difficulty in seeing the small speck of light near Polaris, and I suppose that is owing either to the peculiarity of its hue or to its variability, although I have not read anywhere that it is changeable. Another common but very improper test is the trapezium in Orion, as it is scarcely sufficiently high to clear the mists of the horizon. The sixth star may at one time be visible in a telescope, and at another be invisible in one of far greater power. Dawes says that it is decidedly variable to the extent of at least one magnitude of Struve's scale. If this be so, it has at its minimum scarcely one-fourth of its light at the maximum, Such an object is evidently a very bad test for the telescope. No variable star, nor binary whose components are constantly changing their relative positions, ought to be adopted as test objects; because after the lapse of a certain time they are either more easy or more difficult. Some test their instruments on the planets, and condemn them unless they perceive the features they have read of in astronomical books, or seen in pictures. Now, an instrument may be an excellent one, and not exhibit these features. Even Dawes, using the best instruments manufactured by Clarke and Cooke, could never make out any markings on Venus, whereas Mr. Holden, of London, saw them very distinctly with an ordinary 3-inch achromatic. Again, as is mentioned in the *Astronomical Register* for 1865, that Dawes and Barneby, using achromatics of $8\frac{1}{4}$ and 9-inches, could not see a penumbra to the shadow of any of the satellites of Jupiter when they were in transit, whereas Gorton with a 3⅜-inch achromatic easily perceived that phenomenon, which he compared to the penumbra of a solar spot. If beginners attended to these matters they would be less inclined to blame their telescopes and the opticians who manufactured them.

I am, sir, yours,

J. S.

ON THE MINOR PLANETS.

Dear Sir,—To enable me to state clearly what I wish to advance about the minor planets, you must kindly allow me to say a few words concerning the other members of the solar system. For many years I looked on the primary planets, when only eleven were known to us (from Mercury to Uranus), as all forming only *one* great class of heavenly bodies. The years 1845, 1846, and 1847, increased the number to sixteen, and called especial attention to the planetary worlds. The new minor planets taught us to examine the specialites of the planets generally. The major planets, with their new companion Neptune, presented their mighty orbs to us with peculiarities, in which they differed from all the others, and appeared, with their days of ten hours, as a distinct class. The four next the sun (our old friends), then exhibited their peculiarities, which they all had, and by which they were distinguished from all the other planets, thus establishing a claim to be considered a group in themselves, having their days of 24 hours. Though thus in separate groups, they were all *planets* moving under planetary laws round the great central sun. They also had in their differences a striking similitude—see their diameters bearing the same proportion to each other—here the earth 8,000, there Jupiter above 80,000; here Venus upwards of 7,000, there Saturn upwards of 70,000; here Mars 4,000, there Neptune 40,000, nearly; here Mercury 3,000, there Uranus a little more than 30,000; the inner group showing 3,000, 4,000, 7,000, and 8,000, nearly; the major planets very close on 30,000, 40,000, 70,000, and 80,000. When we look on them as being two separate and distinct families of planets we recognise no necessity for one planet between them to complete a system. Bode's law (that of Bonnet or of Titius rather), is interesting, but it is empirical—*i.e.*, a quack law, and proves nothing. As to the vast chasm between Mars and Jupiter, it cannot be considered so great as often represented when we calculate the much vaster intervals between the four major planets. When we are satisfied that we have, in the solar system, two distinct groups formed by the above, we may turn to the consideration of

THE MINOR PLANETS.

Here I contend we have a third group, being like the other two *sui generis*, yet obeying the same laws, and to all intents and purposes not planetoids, but perfect and complete planets. They chiefly differ from the planets of the other groups, in their great numbers, and in their comparatively small magnitudes; the former flows naturally from the latter, and both peculiarities should intensify our interest in their discovery. Let no one call them *chips* and *bits*, or even by the more respectable term *fragments*. What might a Jovian say of our earth? At a meeting of their R.A.S., held on the planet Jupiter, which is one thousand times greater than our little residence, how easily could he prove that animal life could not be supported on such a diminutive little spot. A man who ever had a look through a microscope should not speak so.

But regarding the diameters of these minor planets, perhaps we shall find, that they are all right and just what they should be. Very high authorities say that the smaller ones are from 300 miles in diameter, and that the larger ones are under 1,000 miles, what do these measurements tell us, but that they are in magnitude to those of our group as ours are to the greater planets. Let us not be surprised at this proportion appearing here, for we find that it goes on higher as well as lower. Jupiter's diameter may be, to the very mile, one-tenth of the diameter of the centre of the system—of the sun himself. As to their being so numerous, I shall not say what I think, lest some of our computers would come down upon me for attempting to disturb Mars in his orbit (see *Le Verrier's* paper in Monthly Notices xiv. 62.) I must now conclude, not for want of more to say, but because I am unwilling to take up more of your valuable pages. Before I do so, allow me to state what Sir John Herschel said concerning the fragmentary theory:—"This may serve as a specimen of the dreams in which astronomers, like other speculators, occasionally and harmlessly indulge."

These minor planets, on which many pages used to be written, in all astronomical periodicals, are now much disregarded; yet they move on each in its appointed bright path in the starry firmament exemplifying Addison's beautiful lines—

"For ever singing as they shine,
The hand that made us is divine."

They manifest, in my opinion, so much of life and beauty that the fragmentary theory seems to me, like a proposal that we should look on the beauteous humming birds, not as real birds, but as fragments of some bird of Paradise blown to atoms.

Dear Mr. Editor, bear with your aged friend,

Angela Gardens, October 18th, 1872. SENEX.

P.S.—That I have a right to sign my letter as I have done, will appear when I tell you that I lately gave an eminent astronomer an account of the exact appearance in Ursa Major, of the comet of 1811, which comet I remember better than those of 1861.

THE NEBULA IN PLEIADES.

It would appear that Mr. Grover considers that this nebula has probably not changed for thousands of years, *because* it was singularly variable a few years ago. One fails to see the force of this reasoning.

He admits that the nebula has been seen with very moderate telescopic power, and he equally admits that he has lately found it a very difficult object with very considerable telescopic power. The inference would seem to be that it has varied. But, "No," says Mr. Grover; for, years years ago, it was more than once found to be a difficult object with very powerful telescopes. What does this prove, except that years ago the nebula was varying?

How a nebula can be at one time an easy object, and at another (no matter whether the next week, or the next year, or the next century), a very difficult one, and yet not be variable, is the problem Mr. Grover has to solve. I fancy it will "take him all his time," after the manner of speaking.

FACTS RATHER THAN FANCY.

NEW RED STAR.

Sir,—In No. 1902 of the *Astronomische Nachrichten*, Mr. J. F. Julius Schmidt, the astronomer of the Observatory at Athens, says, that on the 18th of July of the present year, he discovered a star, the glowing fiery-red colour of which is more strongly marked than in *μ Cephei*, or in R *Leporis*.

The following is the position of this star as given by Mr. Schmidt:—

R.A.	Declination.	Magnitude.
18h. 56m. 56s.	South 5° 53′·4	7·8

Mr. Schmidt remarks, that though the star in question was observed both by La Lande and by Bessel, neither of them notices its peculiar colour; he, moreover, states that this star is not inserted in the list of coloured stars published either by Secchi or by Schjellerup.—I am, sir, yours truly,

W. G. LETTSOM.

Lower Norwood: 23rd Sept., 1872.

CONNECTION OF METEOROLOGY AED ASTRONOMY.

Sir,—Before proceeding to other records, permit me to make a few remarks on the records of storms and rainfall in the September *Register*.

The number of storms per year at Toronto (average of 20 years) has been 33. But at the sun-spot max. of 1860, the number was more than doubled, three years giving 240 storms, or 74 per year. Again, the sun-spots reached their maximum late in 1870, or early in 1871, I think the latter, for the five years previous we had an average of only 19 storms, whilst last year we had 63 occasions in which the wind moved more than 30 miles per hour, and storms are very numerous at present. But the storms commenced a year before the sun-spots reached their max. in 1860, and this storm period does not appear to have begun before the max. of sun-spots. This seems to show that solar energy is not the direct cause of storms, but that some common cause may affect both earth and sun.*

In relation to the record of rainfall, I wish to observe, that the curve formed by the numbers does not run parallel with the curve of sun-spots; the rain curve at Toronto at the first glance seems to be very irregular; but a little examination shows that there have been two depressions between each max. and min. of sun-spots, and one large wave between the min. and max.

We look a little closer and we find, 1st, that the driest years have been at the maximum and minimum years of spots; 2nd, that the wettest years have been the years preceding the dry years; 3rd, that the amount of the dry year's rainfall, added to the year which preceded and the one which followed it, gives the sum of 85 inches.

The dry year at sun-spot max. or min. is near 20 inches, the wet one preceding usually about 34, but this is liable to some trifling variation.

Those facts were noticed in 1870, and the rainfall was predicted in the *Toronto Leader*, 33 in. for 1870, 22in. for 1871, and 27in. for 1872. The two which have passed have been correct to the fraction of an inch, and from present appearances the present year will be correct also.

I think it worthy of note that the number of waves in our rain curve is the same as the waves in the temperature curve at Edinburgh, as found in the report of the Astronomer Royal for Scotland, 1871, and that report shows a low temperature at both sun-spot max. and min., much in the same manner as we find a dry period at max. and min. of sun-spots at Toronto.

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* I am glad to see that W. de la Rue, President of the Physical Section of the British Association called attention to this subject at the last meeting of that body. Mr. Meldrum's observations on cyclones and the sun-spot period, seem to me very important. The writer, however, called attention to this connection, and predicted the present storm-period in the *Toronto Leader* more than a year ago.

And in this connection I would remark that the record of rainfall kept at Marrietta in Ohio, coincides closely with the Toronto record. The curve in both cases show a depression on dry weather at max. and min. of sun-spots, and this record extends back to 1826.

The valuable tables lately published by the Smithsonian Institution, under the direction of Prof. Henery, will, when fully examined, doubtless throw much light on this interesting question.

TORONTO TEMPERATURE TABLE.

Year.	Mean Temper.	Year.	Mean Temper.
1840	43·6	1856	42·2
1841	43·9	1857	42·8
1842	44·0	1858	44·8
1843	42·4	1859	44·2
1844	44·5	1860	44·3
1845	44·6	1861	44·2
1846	46·4	1862	44·4
1847	43·7	1863	44·6
1848	45·1	1864	44·7
1849	44·1	1865	44·9
1850	44·4	1866	43·5
1851	44·6	1867	43·8
1852	43·8	1868	43·3
1853	44·8	1869	43·1
1854	45·2	1870	45·9
1855	44·0	1871	46·0 ?*

The foregoing table shows a decided low temperature at every minimum of sun-spots.

I remain, truly yours,
A. ELVINS.

P.S.—In reply to the remark of "Observer" in the August *Register*, I wish to say that my observation in the *Toronto Telegraph* in 1870, was rather the conclusion of others than my own (Lardner was my chief authority). At present I think it quite likely that planetary positions must have more or less to do with weather; indirectly, however, I shall be glad to follow this subject with "Observer" at some future time. I would be much pleased if he would send me his address.—A.E.

NEW DOUBLE STAR NEAR 43, *DELPHINI.*

About two weeks since I had the pleasure of using for one evening Prof. Young's magnificent Alvan Clark Refractor of 9·4 in. aperture, at the Dartmouth College Observatory; and, although the night was a very poor one, I found one close double star worthy of note. About 25′, almost exactly north of that fine pair, 43 Delphini (Σ 2723), will be seen a wide pair of 8½ m. stars about 100″ apart. The north star of this pair is the one in question. The components are nearly equal, and the distance estimated at 0″·7. It is a very difficult object with my instrument of 6 in. aperture, and the very best weather is necessary in order to see it well. This star is Weisse XX., 977, and its place for 1870:—R.A., 20h. 38m. 49s.; Dec. 12° 15′.

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* There may be a fraction of error in the last year, as in this case I trust to memory not having the record at hand.

There are two very faint companions to 43 Delphini, *n p*, the three being in a line, and the nearest some 20″, or 30″ distant from the primary. The brightest of the two I had detected with my own instrument last year, but the other is still more minute, and I think beyond the reach of a 6-inch. Neither of these faint stars are mentioned in any of the catalogues.

Chicago: September 10. E. W. BURNHAM.

DISCOVERY OF THE PLANET VESTA.

Sir,—I see by M. Arago's "Popular Lectures on Astronomy" (translated with notes, by W. K. Kelly, B.A., 1854), that the planet Vesta was discovered by a *pupil* of Olbers, and not actually by this astronomer himself, as I have always imagined. Surely if this is the case some credit is due to the pupil, though the discovery may have been made through the instrumentality of Olbers. I shall be glad if any of your readers can give me any information on this matter.

I am, Sir, your obedient servant,

October 17, 1872. J. S. G.

NEW DOUBLE STARS.

Sir,—I beg to call attention to three close and interesting double stars discovered within the last week with my 6-inch Alvan Clark Refractor.

AQUARIUS.—This pair is in the same low power field, with 60 Aquarii, 12′ 39″ exactly south. The magnitudes are about 8½ and 9½, D=2″, P=210°. A 13 m. star 20″ or 30″ from the primary *s p* makes it triple. By some oversight 60 Aquarii is not shown on Proctor's Atlas. It is the first star visible to the naked eye south of *η* Aquarii, the two being about 1½° apart. The place (1870) of this triple is as follows:—R.A., 20h. 38 m. 49 s.; Dec. S 12° 15′.

PISCES.—This very beautiful pair is 1m. 30s. *p* 7 Piscium, and is the brightest of four stars in the same field, forming a small trapezium. The distance will not much exceed 1″, the magnitudes being 8½ and 9 or 9½. This is is an elegant object, and a rather difficult one with a small aperture. This star is Weisse XXIII., 229. R.A., 23h. 12m. 12s.; Dec. N. 4° 42′.

SAGITTARIUS.—A very close and nearly equal pair, 13′ north of *o* Sagittarii. The distance I estimate at 0″·8. From its small elevation it is a very difficult pair. This star is B. A. C. 6,504, and is rated as 8m. in that catalogue; but it seems at least half a magnitude brighter. Its place is R.A. 18h. 56m. 33s.; Dec. S. 22° 1′.

A few weeks ago I forwarded a note in reference to two new double stars in Sagitta, but at that time could not give the catalogue position. The first and closer of the two pairs is Lalande, 38,415 7m. R.A., 19h. 59m. 27s. Dec. N. 15° 8′. This is rated by Argelander (+15° No. 4,040) as of the 6m. The second double star is Weisse XIX., 2,025, 8m., rated by Argelander (+15° No. 4,047) as 7m. If any observer is able to see the first well with an aperture much below 6-inches I should be glad to see it stated. All the places are for 1870.

I have now originals or copies of all the double star catalogues and lists heretofore published, so far as I am aware, and none of them embrace any of the doubles in question. In the *Astronomical Register* for August brief mention was made of 12 Scorpii, which star I now find is in Herschel's "Cape of Good Hope Observations," a work at that time I had never seen.

Chicago: September 12. S. W. BURNHAM.

NEW DOUBLE STARS.

Dear Sir,—I have been very much interested by Mr. Burnham's letter in the last number of the *Register*. That he should have been able, with his aperture of 6 inches to see so delicate a star as his X, speaks volumes for the great excellence both of his eye and his instrument. I cannot find this star (X) in any of my double-star catalogues, and I think it will prove to be hitherto unknown.

Mr. Burnham's other star (Y) seems to me very evidently No. 2629 of Struve's Dorpat catalogue (1827). This catalogue, it is well known, is the foundation of the Mensuræ Micrometricæ. No. 2629 is thus described—

R.A. 19h. 59·5m., Dec. + 15° 35′ (Epoch 1826) IV. (8) (10).

The Roman numeral IV. refers to Sir William Herschell's class IV., of stars between 16″ and 32″ distance. This is wider than Mr. Burnham's estimation, but it should be borne in mind that in the case of these very delicate stars, the most experienced observers are frequently at fault in estimations of distance. No. 2629 is one of the *rejectæ* of the Mensuræ Micrometricæ, rejected because "the Comes is less than the ninth magnitude."

The pair F of Mr. Burnham's map is evidently No. 397 of Struve's Poulkova catalogue of double and multiple stars (1843), generally quoted as Otto Struve's. It is described as follows for Epoch 1840:—

R.A. 19h. 57m. 26s. Dec. + 15° 27′ (7·8) (8) mag. Cl. IV.

This Class IV. is again the same as Sir W. Herschel's, comprising stars of which the distance is from 16″ to 32″.

I have been interested by comparing Mr. Burnham's map with Argelander's wonderful charts. I think I can identify all Mr. B.'s stars with those in Argelander's map, which, however, contains many additional stars not shown in Mr. Burnham's delineation. The stars F, X, and Y, seem to be respectively the stars No. 4,038, 4,040, and 4,047, of Argelander's zone + 15°, though Argelander's magnitudes are greater than those assigned by Mr. Burnham, possibly from a different scale being employed. Bad weather and other unavoidable impediments have hitherto prevented my examining this interesting group with my 8-inch equatorial.

Yours truly,
GEORGE HUNT.

Chad Road, Edgbaston, Birmingham :
October 11, 1872.

STARS ON MOON'S DISC IN OCCULTATIONS.

Sir,—The projection of a star on the disc of the moon in an occultation, is a phenomenon, the cause of which is so little understood, that all careful observations of it should be recorded in the hope that a fair explanation may be ultimately obtained.

On September 24th, 1872, I observed the occultation of ε Geminorum, with an 8½ inch silvered glass reflector, by Browning, of excellent definition, the power used being an achromatic eyepiece of 144. The atmosphere was very clear, and free from cloud or haze.

The star approached the moon flashing a good deal, and of a decidedly yellow colour, almost orange. The bright limb of the moon, on account of the low attitude, was not steadily and sharply defined, but boiling a little. On the star coming in contact with the apparent limb of the moon it gradually diminished in brightness, lost all its flashing and its yellow colour, and encroached on the surface of the moon as a round white disc like a little planet cleanly defined. The star had passed *through* the rather boiling edge of the moon and appeared on the even surface of the moon's disc before it disappeared. The time from the moment it began to diminish in brightness till it disappeared was about four seconds. On disappearing, the little white disc, which had no stellar character at all about it, seemed to hang or pause for an instant and then vanished.

The re-appearance of ε Geminorum and its 9.5 magnitude comes was satisfactorily observed about 1h. 0m. 30s. after disappearance. It "started into light" as yellow and flashing, nearly as much as when first observed prior to occultation.

The Astronomer Royal's explanation of such phenomena, as quoted from the "Memoirs of the Astronomical Society" in Lardner's handbook, seems to account for the star diminishing in brightness, but it hardly explains the change of colour observed. Admiral Smyth (Cycle vol. ii. p. 103), reports an observation of the projection of Aldebaran on the moon's disc, but makes no mention of diminution of light or change of colour. He says:—"I saw Aldebaran approach the bright limb of the moon very steadily; but from the haze no alteration in the redness of its colour was perceptible. It kept the same steady line to about three-quarters of a minute inside the lunar disc, where it remained as precisely as I could estimate 2¼ seconds, when it suddenly vanished."

At the meeting of the Royal Astronomical Society, January 11th, 1867, it was stated that—"Mr. Airy remarked at the occultation of Aldebaran the star did not come out bright instantaneously but was 38 seconds regaining its full light."

This, I presume, refers to the occultation of Aldebaran, on November 22nd, 1866, when the star reappeared about 12¼ hours after full moon, and so close therefore to the bright terminator of the moon, that possibly under the Astronomer Royal's explanation referred to above, the retardation of the star's regaining its full light might be due to the same effects of irradiation which produced the diminution in the light of ε Geminorum I noticed.

This phenomenon appears to have been frequently observed with Aldebaran, but I cannot ascertain that it has been ever noticed in occultations of stars of the third magnitude, though I cannot doubt that observers, using powerful telescopes, have often found it to be the case.

Stormy weather unfortunately prevented me observing the occultation of κ Geminorum on the 25th. I trust if any of your readers witnessed either of these occultations they will favour you with their results.

I am, Sir.
Your obedient servant,
E. B. KNOBEL.

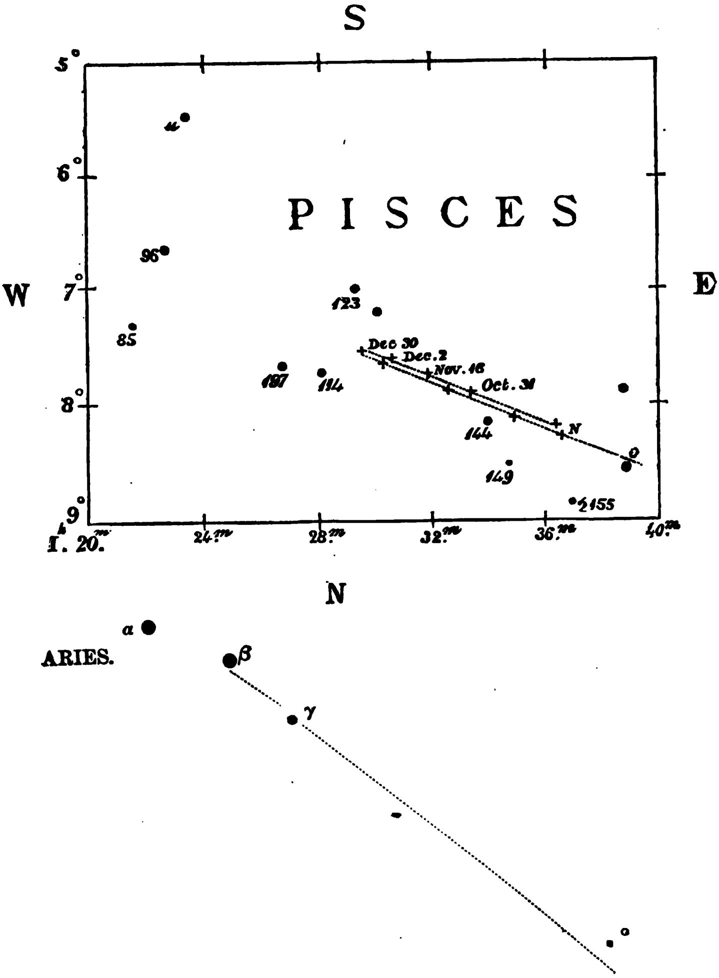
Burton-on-Trent,
Sept. 26th, 1872.

P.S.—I should add that the atmosphere was so clear that the re-appearance of ε Geminorum would have been visible without a telescope. The instant after it appeared I had no difficulty at all in seeing it with the naked eye.

It may not be generally known that amongst other works translated of late years into the Chinese language are the following:—Herschel's *Outlines of Astronomy*, by Wylie, 3 vols., sm. folio, China, 1859; De Morgan's *Algebra*, by the same, 8vo, 1859; Mac Gowan's *Law of Storms*, China, 1853; Milner's *History of England*, abridged, by Muirhead, Shanghai, 1856. There is also a Treatise on Arithmetic, in Chinese, by Wylie, 1853.—See Bernard Quaritch's "Catalogue of Oriental Literature, &c.," Sept., 1872.

PATH OF NEPTUNE (N.).

From October 3rd, 1872, to April 15th, 1873 (inverted view).



A line joining β and γ Arietis, prolonged downwards to a distance from γ equal to ten degrees, or less than twice the distance between α and γ, passes to the left of *o* Piscium, fifth mag. Having found this star, the diagram will readily enable Neptune to be identified. He appears about the same size as the star 149, eighth mag. In the beginning of 1873, the planet commences a direct movement a little to the N, of its previous path. Its places are marked for January 29, February 26, March 18 and 30, and April 15; on April 14 it will be about 2¾′ below *o* Piscium.

Two other objects marked in the diagram are well worth looking at, Σ 155 and 123, close double stars. See Webb's "Celestial Objects," &c.

GEORGE J. WALKER.

QUERY. DOUBLE STARS.—What are the best authorities on the double stars south of the equator (I mean south declination), and where are the catalogues, if any, published? I have Sir John Herschel's "Cape observations."—M. J.

THE PLANETS FOR NOVEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m
Mercury ...	1st	15 13 35	—19 11½	4″·8	0 29·2
	15th	16 39 45	—24 30½	5″·4	1 0·1
Venus ...	1st	16 23 13	—22 32	11″·6	1 38·6
	15th	17 37 58	—24 50	12″·2	1 58·1
Jupiter ...	1st	10 3 34	+12 46	33″·2	19 16·1
	15th	10 9 35	+12 16	34″·5	18 27·1
Saturn ...	1st	19 10 17	—22 25	14″·4	4 25·1
Neptune ..	4th	1 33 3	+ 7 49		10 35·2
	16th	1 31 56	+ 7 43		9 46·9

Mercury sets about twenty minutes after the sun at the beginning of the month; the interval increasing to an hour at its end.

Venus is getting into a good position for observation. Towards the end of the month she sets about two hours after the sun.

Jupiter rises after sunset after the 4th, and may be observed for the rest of the night.

Neptune is well situated for observation.

MINIMA OF ALGOL—According to Schöenfeld.

1872.	Nov. 2.	17·1h.	G.M.T.	Dec. 1	9·2
	5.	13·9		4.	6·1
	8.	10·7		15.	17·3
	11.	7·5		18.	14·2
	25.	15·6		21.	11·0
	28.	12·4		24.	7·8

ASTRONOMICAL OCCURRENCES FOR NOVEMBER, 1872.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Fri	1	 10 8 15 20	Sidereal Time at Mean Noon, 14h. 44m. 19·12s. Conjunction of Mars and σ Leonis (2·1m.), E. Conjunction of Moon and Mercury 2° 25′ S.	1st Tr. I. 3rd Sh. I. 1st Sh. E. 1st Tr. F. 3rd Sh. E.	13 44 13 55 14 52 16 4 17 38	α Pegasi — 8 12·7
Sat	2	23 39	Conjunction of Moon and Venus, 0° 25′ S.	1st Oc. R.	13 23	8 8·8
Sun	3					8 4·9
Mon	4		Sun's Meridian Passage, 16m. 17·72s. before Mean Noon	4th Oc. D.	17 47	8 0·9
Tues	5	13 5	Conjunction of Moon and Saturn 3° 38′ N.	2nd Sh. I.	16 39	7 57·1
Wed	6	7 38	Conjunction of Jupiter and α Leonis (4·2m.), W.			7 53·1
Thur	7	15 51 9 45	☽ Moon's First Quarter Conjunction of Mercury and δ Scorpii 0° 12′ S.	2nd Oc. R. 1st Ec. D.	16 20 17 18 13	Moon. — 5 47·0
Fri	8			1st Sh. I. 1st Tr. I. 1st Sh. E. 3rd Sh. I. 1st Tr. E.	14 25 15 39 16 46 17 53 17 59	6 42·9
Sat	9					7 35·3
Sun	10					8 24·7
Mon	11					9 12·3
Tues	12		Saturn's Ring: Major Axis=35″·63 Minor Axis=14″·66	3rd Oc. D. 4th Sh. I. 3rd Oc. R. 4th Sh. E. 2nd Sh. I.	13 5 13 44 16 47 18 40 19 12	9 59·2
Wed	13	7 33 8 34 16 10 17 2	Occultation of B.A.C. 728 (6½) Reappearance of ditto Occultation of 31 Arietis (6) Reappearance of ditto			10 46·4
Thur	14	17 8 19 5	○ Full Moon Eclipse of the Moon Occultation of B.A.C. 1096 (5½)	2nd Ec. D. 2nd Oc. R. 1st Ec. D.	13 32 18 18 58 19 11 17	11 34·7
Fri	15	 15 16 16 27	Illuminated portion of disc of Venus = 0·853 Illuminated portion of disc of Mars = 0·913 Occultation of 53 Tauri (6) Reappearance of ditto	1st Sh. I. 1st Tr. I. 1st Sh. E.	16 19 17 34 18 39	12 24·7

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Moon. —
Sat	16		Sidereal Time at Mean Noon, 15h. 43m. 27·46s.	2nd Sh. E. 1st Ec. D. 2nd Tr. E. 1st Oc. R.	11 24 13 39 35 13 57 17 12	13 16·1
Sun	17	 6 7	Sun's Meridian Passage, 14m. 47·14s. before Mean Noon Occultation reappearance of 132 Tauri (5½)	1st Tr. I. 1st Sh. E. 1st Tr. E.	12 3 13 8 14 23	α Pegasi — 7 9·8
Mon	18	6 17	Occultation reappearance of ε Geminorum (3½)	1st Oc. R.	11 41	7 5·9
Tues	19	8 49	Near approach of κ Geminorum (3½)	3rd Ec. D. 3rd Ec. R. 3rd Oc. D.	12 4 23 15 38 15 17 6	7 1·9
Wed	20	7 31 12 19	Conjunction of Mars and β Virginis 9·2m. W. Conjunction of Moon and Uranus 4° 10′ S.			6 58·0
Thur	21			4th Oc. D. 2nd Ec. D. 4th Oc. R.	12 11 16 7 53 17 2	6 54·1
Fri	22	17 45 12 55 18 37	☾ Moon's Last Quarter Conjunction of Moon and Jupiter, 4° 42′ S. Near approach of B.A.C. 3579 (6)	1st Sh. I. 1st Tr. I.	18 12 19 28	6 50·1
Sat	23			2nd Sh. I. 2nd Tr. I. 2nd Sh. E. 1st Ec. D. 2nd Tr. E. 1st Oc. R.	11 2 13 37 13 58 15 32 36 16 31 19 6	6 46·2
Sun	24			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	12 41 13 56 15 1 16 16	6 42·3
Mon	25	0 5	Conjunction of Moon and Mars, 3° 26′ S.	2nd Oc. R. 1st Oc. R.	10 52 13 34	6 38·4
Tues	26	17 56 18 53	Occultation of ℓ^2 Virginis (5) Reappearance of ditto	1st Tr. E. 3rd Ec. D. 3rd Ec. R.	10 44 16 1 52 19 35 42	6 34·4
Wed	27					6 30·5
Thur	28			2nd Ec. D.	18 43 34	6 26·5
Fri	29			4th Sh. E. 4th Tr. I.	12 37 19 29	6 22·7
Sat	30	6 34	● New Moon	2nd Sh. I. 3rd Tr. E. 2nd Tr. I. 2nd Sh. E. 1st Ec. D.	13 35 14 30 16 8 16 31 17 25 36	6 18·7
DE *Sun*	C. 1	9 58 19 43	Conjunction of Mars and η Virginis (3·1m.) W. Conjunction of Moon and Mercury, 0° 35′ N.	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	14 34 15 48 16 54 18 8	6 14·7

SUN.

Greenwich, Noon, 1872.	Heliographical western longitude of the centre of the sun's disc.		Heliographical latitude of the centre of the sun's disc.	Angle of position of the sun's axis.
	°		°	°
Nov. 1	331·38	13·20	+4·11	24·52
2	344·58	13·20	4·00	24·34
3	357·78	13·20	+3·89	24·15
4	10·98	13·20	3·79	23·95
5	24·18	13 20	3·68	23·75
6	37·38	13·20	3·57	23·54
7	50·58	13·20	3·46	23·32
8	63·78	13·20	3·34	23·09
9	76·98	13·20	3·23	22·85
10	90·18	13·20	+3·12	22·61
11	103·38	13·20	3·00	22·36
12	116·58	13·20	2·88	22·10
13	129·78	13·19	2·77	21·83
14	142·97	13·20	2·65	21·56
15	156·17	13·20	2·53	21·28
16	169·37	13·20	2·41	20·99
17	182·57	13·20	+2·29	20·69
18	195·76	13·19	2·17	20·39
19	208·96	13·20	2·05	20·08
20	222·16	13·19	1·93	19·76
21	235·35	13·20	1·80	19·43
22	248·55	13·20	1·68	19·10
23	261·75	13·19	1·55	18·76
24	274·94	13·20	+1·43	18·41
25	288·14	13·19	1·30	18·06
26	301·33	13·19	1·18	17·70
27	314·52	13·20	1·05	17·33
28	327·72	13·19	0·92	16·96
29	340·91	13·20	0·80	16·58
30	354·11	13·19	0·67	16·19
Dec. 1	7·30		0·54	15·80

Daily rate of rotation, 14°·20.

MOON.

	LIBRATION. Selenographical colong. and lat. of the point on the moon's surface which has the *Earth's* centre in the zenith.		SUN'S PLACE. Selenographical colong. and lat. of the point on the moon's surface which has the *Sun's* centre in the zenith.		TERMINATOR. Selenographical colong. of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets.		
12h. Greenwich mean time.	colong.	lat.	colong.	lat.	60° N.	0°	60° S.
1872.	°	°	°	°	°	°	°
						SUNRISE.	
Nov. 6	90·34	+5·63	345·10	+0·52	76·0	75·1	74·2
7	89·30	6·39	357·27	0·50	88·1	87·3	86·4
8	88·27	6·76	9·44	0·47	100·2	99·4	98·6
9	87·29	6·72	21·60	0·44	112·3	111·6	110·8

10	86·42	+6·29	33·76	+0·42	124·5	123·8	123·1
11	85·71	5·48	45·90	0·39	136·6	135·9	135·3
12	85·18	4·37	58·05	0·36	148·7	148·1	147·5
13	84·90	3·03	70·19	0·32	160·7	160·2	159·6
14	84·87	1·53	82·33	0·29		SUNSET.	
15	85·11	+0·02	94·46	0·26	4·0	4·5	4·9
16	85·62	—1·49	106·60	0·23	16·2	16·6	17·0
—							
17	86·37	—2·89	118·74	+0·20	28·4	28·7	29·1
18	87·35	4·13	130·88	0·17	40·6	40·9	41·2
19	88·48	5·18	143·03	0·13	52·8	53·0	53·3
20	89·73	5·98	155·18	0·10	65·0	65·2	65·4
21	91·02	6·53	167·33	0·07	77·2	77·3	77·5
22	92·28	6·80	179·49	0·05	89·4	89·5	89·6
23	93·44	6·77	191·66	+0·02	101·6	101·7	101·8
—							
24	94·44	—6·45	203·83	—0·01	113·8	113·8	113·8
25	95·18	5·82	216·01	0·04	126·1	126·0	126·0
26	95·64	—4·89	228·19	—00·7	138·3	138·2	138·1

Colong. = 90° —λ.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN NOV., 1872.

By W. R. Birt, F.R.A.S., F.M.S.

On p. 226 of the September number of the present volume the value of supplement of ☾ — ☉ on August 18, 1871, is quoted at 147° 16′·7, and on p. 240, of vol. ix., the value of supplement ☾ — ☉ is given as 143° 10′·9 on October 16, 1871. On November 3 supplement ☾ — ☉ = 144° 40′·7. The lists for August and October, 1871, may be consequently consulted for the selection of objects for observation in November, 1872.

Eleventh Zone of objects from North to South, 25° *to* 30° *W. long.*

Euctemon (east part), Meton,* (west part), Baily, Burg, Plana, Lacus Mortis, Posidonius, Mount Argæus, Dawes (*a*), Jansen, Maskelyne,* Mädler (*b*), Theophilus, Beaumont, Riccius, Nicolai,* Pitiscus,* Mutus, Manzinus, Schomberger (the middle part).

Objects marked thus (*) have not been mentioned in the monthly lists.

(*a*) The crater N.W. of Plinius has been named DAWES.

(*b*) The crater N.W. of Theophilus has been named MADLER, by Schmidt.

My thanks are due to the author of the positions of the terminator, etc., for furnishing the readers of the *Register* with some remarks relative to the choice of a well marked fundamental point of reference near the middle of the moon's disc, on which, perhaps, I may be permitted to offer briefly my views. I perfectly agree with the proposal for "a correct survey of a great many of the leading points of the moon's disc," as essential for the progress of selenography, and I should much like to see not only the determination of the selenographical cöordinates of Mösting A, or Triesnecker B, by means of a new and special investigation of the moon's librations, but the mode to be adopted with the requisite measures and formulæ for deducing the cöordinates of the leading points from the cöordinates of the fundamental point of reference, and how far such measures and formulæ may differ from the mode of determining points of the second order adopted by Mädler. As the accuracy of Mädler's points of the first order has been called in question would it not be well in the new triangulation proceeding from the fundamental point to redetermine each of Beer and Mädler's points of the first order, so that their triangles may, by the determination of included points, be divided into several smaller triangles ? This would contribute to a real and important advance in selenography.

ECLIPSE OF THE MOON.

Partial eclipse of the moon, visible at Greenwich, November 14.

	G. M. T.
First contact	15 1·7
First contact with the shadow	17 1·7
Middle of the eclipse	17 19·4
Last contact with the shadow	17 37·1
Last contact with the penumbra...	19 37·1

Magnitude of the eclipse = 0·023

MINOR PLANETS.

The following minor planets *) come into opposition :—

1872.				Mag. m.	A.R. h.	A.R. m.	P.D. °
Nov. 2	Cassandra	(114)	...	11·1	2	54	80·2
3	Alexandra	(54)	...	11·3	2	34	55·8
4	Antiope	(90)	...	11·6	2	40	76·1
5	Proserpina	(26)	...	11·0	2	44	74·3
5	Pandora	(55)	...	10·1	2	43	67·0
6	Daphne	(41)	...	11·5	3	4	89·2
8	Lydia	(110)	...	10·7	3	0	74·8
10	Eugenia	(45)	...	11·1	3	3	82·9
12	Isis	(42)	...	10·3	3	11	81·1
Dec. 5	Maja	(66)	...	11·7	4	55	62·3
8	Leto	(68)	...	10·5	4	57	60·7
13	Victoria	(12)	...	10·8	5	26	72·7
16	Lomia	(117)	...	11·3	5	49	44 5
21	Calliope	(22)	...	9·1	6	2	57·7
24	Sirone	(116)	...	10·4	6	19	63 8
26	Sappho	(80)	...	10·5	6	21	79·2
27	Thisbe	(88)	...	11·7	6	27	66·5

*) or "Zenareides," if an old suggestion of a name, which would embody the chief characteristic of their orbits, be fancied.

Erratum in last number. Page 233, line 13 from top, dele the comma between "Pallas" and "Athena." (It is of course one name.)

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Sept., 1872.

Barneby, T.
Rivaz, Miss
Walton, T.

To Nov., 1872.

Hutchings, Rev. R. S.

To Dec., 1872.

Adams, S.
Cook, James
Cundell, G. S.
D'Alquen, F. M.
Dix, F.
Freeman, G. T.
Hemming, Rev. B. F.
Lancaster, J. L.
Lancaster, W. L.
Numsen, W. H.
Perrins, J. D.
Petty, Thomas
Rump, H. R.
Shawcross, W.
Vines, D.
Watson, J.

To Jan, 1873.

McAdam, J. V.

To March, 1873.

Court, T.
Hendry, W.

To June, 1873.

Dale, R. S.

To Dec., 1873.

Birt, W. R.
Horner, Rev. J.

TO CORRESPONDENTS.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, Hackney Collegiate School, *Clarence Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 120. DECEMBER. 1872.

ROYAL ASTRONOMICAL SOCIETY.

Session 1872—73.

First Meeting, November 8th, 1872.

Professor Arthur Cayley, F.R.S., *President,* in the Chair.

Secretaries—E. Dunkin, Esq., and R. A. Proctor, Esq.

The minutes of the last meeting were read and confirmed.

One hundred and sixteen presents were announced, and the thanks of the Society voted to the respective donors. A portrait of the late Sir James Clarke Ross, the arctic and antarctic explorer, and the Report of the Italian Astronomers of their observations on the Eclipse of 1870, very beautifully got up and illustrated, were among the presents.

Mr. Dunkin announced that two more minor planets had been discovered at Paris on the night of the 5th—6th November; the first by M. Paul Henry, and the second by M. Prosper Henry. They are both about 11½ magnitude, and make the number of planetoids now 127.

A. H. Hadley, Esq.

was balloted for, and duly elected a Fellow of the Society.

M. Janssen, Professors Simon Newcombe, H. A. Newton and Respighi, Dr. Rutherfurd, and Professors Schiaparelli, Young, and Zollner, having been duly recommended by the Council, according to the bye-laws, were balloted for and elected Foreign Associates of the Society.

The following papers were announced and some of them read:

Mean places of 78 *Stars near the South Pole, observed at the Royal Observatory, Cape of Good Hope*: by Mr. E. J. Stone.

Mr. Dunkin said that although much occupied in reducing past observations, Mr. Stone had not neglected current work, and that this was probably one of the most important contributions from the southern hemisphere which the Society had ever received.

Sir G. B. Airy, Astronomer-Royal, remarked that the meeting ought not to pass over this valuable paper without animadverting to the great difficulty under which the work had been performed, Mr. Stone having unexpectedly to struggle with the masses of unreduced observations left by his predecessor at the observatory.

Ephemeris of the angle of position and distance of the Binary Star, a Centauri: by Mr. Hind.

The author called attention to the interesting changes about to be witnessed in this system at the nearest approach of one star to the other, which he had calculated for 1875, the elements used being those of Mr. Eyre Burton Powell, of Madras.

Note on the first Comet of 1818: by Mr. Hind.

In the last number of the *Monthly Notices,* Professor Herschel refers to the similarity of the orbit of this Comet and of a periodical meteor shower in December. Mr. Hind now gave a fresh determination of the elements of the former.

Note on the Binary Star a Geminorum: by Mr. Hind.

Several communications have lately been made as to the orbit of this pair, but Mr. Hind points out that the authors have overlooked the elaborate investigations of Professor Thiele, the Danish astronomer, which show that it is quite unnecessary to resort to the improbable hypothesis of hyperbolic motion.

On the probable early appearance of the Comet of the November Meteors: by Mr. Hind.

On Lord Lindsay's preparations for observing the Transit of Venus in 1874: by Lord Lindsay and Mr. D. Gill.

An account of the preparations made for observing the transit of Venus, so far as at present matured, will doubtless be interesting to the Society; but on many points they must stand over for future communications. Lord Lindsay has selected the Island of Mauritius as his station, on account of its more favourable meteorological conditions as compared with other places having greater astronomical advantages. The methods of observation to be employed are: I. Observations of the internal contacts to be worked out on the plans of Halley or Delisle. II. Observations of the first external contact at the chromosphere, to be made with a spectroscope. III. Photographic pictures. IV. Heliometric measures. It has been ascertained that two observers can make use of all these plans, and arrangements have been made accordingly. Each of the methods referred to has its own advantages, and it is desired to combine all if possible. The first method involves a knowledge of the latitude and longitude of the station, and correct time there. It is not yet settled whether any galvanic communications will be available, but at present for the longitude it is intended to use transits of the moon with an altazimuth made by Simms. It is believed the Germans will also have a station on the Mauritius, and will determine their geographical position very carefully; and Lord Lindsay will then connect his station with theirs by triangulation. The transit instrument to be used will be described at a future meeting. It has 4 inches aperture, and is made by Cooke. The clock is one by Frodsham, and there is also a chronograph with 4 barrels, each of which can be worked separately, so that each instrument will have its own recording barrel, thus avoiding all confusion. The chronograph can be kept in motion for 4 hours, which will cover the whole time occupied in the transit. Lord Lindsay intends to observe the external contact with the chromosphere himself, and Mr. Gill the internal contacts with a telescope. It is pretty well understood that the photographs, to be useful, must be 4 inches in diameter; and, in order to obtain perfect pictures, the rays should fall as little obliquely as possible. This appears to be fulfilled by the method proposed by Professor Winlock, who suggests a telescope of 40 feet focal length, placed horizontally, and a heliostat to reflect the sun's image along it. At first, Lord Lindsay ordered a simple lens of Dallmeyer, but has now arranged to ensure the great advantage of an achromatic one, which is promised by the end of this year. It is intended to have 2 planes to the heliostat, one mounted on a polar axis and another to send the rays down the tube. Lord Lindsay had never met with an instrument that answered his requirements until he saw the siderostat made by M. Foucault, of Paris, which was the very thing he wanted; and he had accordingly ordered one to be made with 16-inch mirrors. These are unusually large, but the instrument can be applied afterwards to other purposes. Much fear has been expressed, especially by Americans, as to the effect of distortion of the apparatus by the heat to which it will be exposed; but Professor Wolff states that no such effect is produced by exposure to the sun's rays for two hours. Mr. Howard Grubb has made a 13-inch unsilvered mirror, to fit the telescope to be taken out. Fiducial lines cannot be relied on, and therefore it may be better to do without them entirely, and make the measures from the centre of the sun, as with the heliometer. As there is a question whether the line of direction can be exactly determined, measures of position angles should be dispensed with as the micrometer gets heated. As to the heliometric method, it is not much in favour in this country, and none of the government expeditions will be supplied with such instruments. The Germans like it better, and will send a heliometer to Kerguelen's Land, as their Mauritius station will not be so good for corresponding with one they intend to occupy in China. The Russians will have them at Lake Baikal and the mouth of the River Amoor. Messrs. Repsold, of Hamburgh, have undertaken to make a heliometer for Lord Lindsay, like the Russian instruments, with all the improvements used in the Oxford instrument as well as some others. It will, therefore, include the motion of the halves of the object glass in curved slides, so that the images will remain in focus; unlimited rotation of the tube in the cradle; the measurement of position angles at the eye end, and measures of the micrometer read there also. Some new points are, the graduation of the slides of the object glass side by side, so as to be read by the same microscope; an arrangement to shut off light from half the object glass, so as to equalise the light of the images; and the introduction of a thermometer at the end of the tube. Most of these improvements were indicated by Struve. Messrs. Repsold only undertake the object glass and tube; the equatorial mounting is to be by Cooke. These details are submitted in the hope that any astronomers used to the instrument will offer their advice and assistance. It is desired by the observations to eliminate personality, and to avoid or properly estimate the effects of changes of temperature and of atmospheric conditions. Lord Lindsay explained, and illustrated by a series of diagrams, the method of observation with the heliometer, and the way in which all the necessary corrections for instrumental errors would be made. He proposed to eliminate errors of division, as affected by temperature, by placing the instrument on one of the collimating piers of his transit circle in his observatory at home, and heating the room by gas to different temperatures. As to the measure of accuracy to be expected from the heliometer results, it was thought that the error of observation would not exceed 0″·5, and that if each series included 10 measures this would be reduced to 0·″1, and if 10 such series were obtained to 0″·056. The effects of such an error on the result would be only 0″·018 of parallax, but it was hoped that the original error would be less than 0″·5, and that therefore the result would be one of extreme accuracy.

On the examination of the Photographs taken during the total solar Eclipse of December 11—12, 1871: by Colonel Tennant.

In his report of the observations at Dodabeta the author expressed his opinion that there was a marked connection between the protuberances and the configuration of the corona, and this upon minute examination of the pictures he finds confirmed. The photographs have been measured as to this point with the assistance of Dr. De la Rue. The negatives were placed in an oxyhydrogen lantern and projected on a card, where they were traced of a size which rendered them capable of being measured in Dr. De la Rue's micrometer. Besides showing the coincidences between the prominences and the rifts of the corona, an attempt was made to deduce the line of the moon's motion from the corona as well as from the passage over the protuberances, and the motion was always found in the right direction. Indeed, the general motion of the moon, with respect to the corona, was found to be the same as with the protuberances. Every peculiarity of the corona, especially the salient points of the rifts, could be traced through all the series, and could be measured with the micrometer used. Thus a long ray, which in No. 1 was very remarkable, was in No. 3 contracted and shorter; but in No. 3 everything was less than in No. 1, so that the result was the same. The measures were made by Dr. De la Rue and verified by Col. Tennant, but he acknowledged that the former were the most reliable. While the examination entirely confirms the general permanency of the corona, it cannot be said that it does any more. The author prefers resting the evidence of the moon's motion on the comparison of his pictures with those taken by Lord Lindsay at Bekul, when the corona was permanent for a time longer than the period occupied in taking the photographs.

On the rate of a clock going in a partial vacuum: by Mr. Carrington.

The author found great difficulty in making the necessary arrangements for procuring the vacuum, as his mahogany clock case leaked and the glass cracked. At last he succeeded with a copper case having a glass front, of which, however, eight were broken before he obtained one strong enough. The paper gave the details of a number of series of observations for clock rate, with a vacuum ranging fram 27·5 to 29 inches, which showed that while the rate remained very uniform at each diminished pressure, an alteration in this produced a marked change in the rate.

On a proposed double altazimuth: by Mr. Carrington.

The author suggested the construction of a new instrument, being a double altazimuth, capable of reversion in all its parts, having open mirrors or lenses without tubes. He described it in great detail with the aid of drawings, but admitted that from its enormous dimensions and consequent expense, it was never likely to be made, if even the difficulty of construction of some parts could be surmounted.

On a modified form of solar eyepiece: by Mr. Browning.

The instrument was exhibited, and Mr. Browning stated that it had seemed to him that in the ordinary construction, the prism being placed with its face at an angle of 45° was about the best position for reflecting all the light possible, instead of getting rid of it. He had, therefore, tilted the prism until the rays fell nearly at a right angle, and the effect was even better than he had expected.

On an observing chair for a reflecting telescope on the Newtonian principle: by Mr. Browning.

This chair was originally designed by Mr. Knobel, who had sent it to Mr. Browning, requesting his opinion and suggestions for its improvement. Mr. Browning exhibited a model, in which he had replaced the solid uprights by hollow tubes, containing counterpoises slightly in excess of the weight of the chair, and by the regulation of these the observer could raise and lower himself with facility.

On the origin of the November meteors: by Mr. Proctor.

In the application of Schiaparelli's theory of the connection between comets and meteors, it had generally been considered that such bodies were drawn into the solar system, in consequence of the attraction of the planets they might pass near. The author observed that a meteor passing near Uranus with a velocity of six miles per second, which corresponded to the known velocity of such bodies near the sun, would lose 4½ miles of such velocity, but to do this it must pass as close as the nearest satellite of Uranus. He thought the probability of this very small, and that there was another way of getting over the difficulty, viz., by supposing that Uranus at some time had expelled these meteoric bodies from its own mass. The force required for this purpose so as to drive the body beyond the sphere of the planet's attraction, would not require a very great velocity, as 13½ miles per second would be sufficient, whereas if expelled from the sun it would have to be 375 miles. If such comets were found to be near Jupiter, they also might easily have been expelled from the planet, instead of being drawn from outer space.

On the diffraction of object-glasses: by Mr. Strutt.

In observing the sun, in order to obviate injurious effects to the eye, it is usual to contract the object-glass, but in doing so definition is sacrificed, and the image becomes a patch of light surrounded by rings. In making star measures, if the aperture be diminished the resolving power suffers. It has occurred to the author that it would be otherwise if the centre of the glass were stopped out, and a ring at the circumference left open, and he entered into a mathematical discussion of the subject.

Capt. Noble said it was a very old dodge in separating double stars to put a patch on the centre of the glass.

Mr. Dunkin said the Astronomer Royal wrote a paper on the subject 40 years ago.

On the arc of the meridian measured in South Africa: by Mr. Todhunter.

The author finding some deficiencies in the account of this operation, is anxious for explanation on certain points.

On a coloured cluster about κ Crucis: by Mr. Russell.

On a volcanic appearance on the sun: by M. Chacornac.

On July 29, this observer saw a great flame on a spot. It seemed to be a shining protuberance 7″ in diameter and of a blue tint.

On the parallax and proper motion of Lalande 21,185: by Mr. Lynn.

Dr. Winnecke having found an approximate parallax of 0″·501 for this star, the author has compared the Greenwich observations of the objects and finds they agree in giving the same proper motion that Argelander does.

Graphic conversion of stellar co-ordinates: by Mr. Freeman.

In order to avoid any difficulty in setting altazimuths, on account of converting R.A. and Declination into altitude and azimuth, Mr. Freeman has constructed a graphic projection of curves, showing the correspondence of the elements, of which he exhibited a photographic copy.

Future solar eclipses: by Mr. Maguire.

On changes in the nebula surrounding η Argus: by Mr. Abbott.

The author sent a fresh drawing and measures of this object.

Observations on the zodiacal light: by Mr. Fasel.

List of co-ordinates of stars within or near the Milky Way: by Mr. Marth.

The meeting then adjourned.

ASTRONOMICAL ALLUSIONS IN HOMER, DANTE, SHAKESPEARE AND MILTON.

By G. J. Walker.

IV.—Milton.

Born 1608; died 1674.

Though the famous work of Copernicus, *De Revolutionibus*, &c., had been published much more than a century before Paradise Lost was written, in that great poem there is only the possibility of its truth expressed. One reason assigned by Addison (Spectator, No. 345), is that "it would have been highly absurd to have given the sanction of an archangel to any particular system of philosophy." Nevertheless Raphael is more than once committed to erroneous physics, or explanation of phenomena (Paradise Lost, V., 415-426; VIII., 145-148). In 1637, Milton visited Galileo in his confinement at Florence. Though he seems to have really held with the great Tuscan, he probably, as science was not his forte, thought it advisable to make the angel withhold his sanction both from the Ptolemaic and the Copernican system. It may be questioned if he would have done so had he lived in later times, when the true system of the universe became generally acknowledged. But the *Principia* of our immortal Newton had not yet appeared. Such systems as the Ptolemaic and Tychonic are described as "quaint opinions":—

——"When they come to model heav'n
And calculate the stars, how they will wield
The mighty frame! how build, unbuild, contrive,
To save appearances; how gird the sphere
With centric, and eccentric, scribl'd o'er,
Cycle, and epicycle, orb in orb."
—Paradise Lost, VIII., 78, &c.

This is spoken by Raphael, who a little further on alludes to the system of Copernicus as follows:—

———"What if the sun
Be centre to the world; and other stars
(By his attractive virtue and their own
Incited) dance about him various rounds?"
—VIII., 122, &c.

But the conclusion is, that Adam is advised by Raphael not to trouble himself about such hidden things as whether the earth moved and revolved on its axis or not. The poet, however, who might easily have avoided the positive adoption of any theory, by representing such matters as left to be unravelled in the course of time by human ingenuity rather than to be taught by revelation, is sometimes scarcely consistent on the ground he has chosen. In Paradise Lost, IV., 593, &c., describing Uriel's descent on the sunbeam back to the sun which had set, he leaves it doubtful:—

————"Whether the prime orb,
Incredible how swift, had thither rowl'd
Diurnal; or this less voluble earth,
By shorter flight to th' east, had left him there," &c.

Yet in IX., 103, &c., Satan speaks of the earth like a decided Ptolemaist:—

"Terrestial heav'n! danc'd round by other heav'ns
That shine, yet bear their bright officious lamps,
Light above light, for thee alone, as seems," &c.

Whilst Raphael appears to have no settled views on the subject:—

"To ask or search, I blame thee not; for heav'n
Is as the book of God before thee set:
Wherein to read his wond'rous works, and learn
His seasons, hours, or days, or months, or years.
This to attain, whether heav'n move or earth,
Imports not, if thou reckon right: the rest,
From man or angel, the great architect
Did wisely to conceal; and not divulge
His secrets to be scann'd by them who ought
Rather admire. Or, if they list to try
Conjecture," &c.—VIII., 66, &c.

Yet who can doubt that angels, both good and bad, must know the truth concerning these things? Remembering the poet's blindness, and the interruptions in the composition of his work, perhaps these inconsistencies are not surprising.

Of now long exploded errors that still linger in Paradise Lost, are the following. An eclipse of the sun is ominous:—

"As when the sun . . .
————from behind the moon,

In dim eclipse, disastrous twilight sheds
On half the nations, and with fear of change
Perplexes monarchs," &c.—I., 596, &c.

This passage, it is said, nearly occasioned the suppression of the poem by the Licenser, whose office had been restored by Charles II. See also "Lycidas."

The well-known allusion to the disastrous influences of comets, II., 708, &c., when Satan,

———"like a comet burn'd,
That fires the length of Ophiuchus huge
In th' arctic sky, and from his horrid hair
Shakes pestilence and war."

And XII., 633, &c.:—

"The brandish'd sword of God before them blaz'd;
Fierce as a comet."

Evil influences of planets and stars are referred to, X., 657-664. See also "Arcades." Stars show the future, Paradise Regained, IV. They derive their light from the sun, Paradise Lost, VII., 364-365; Harmony of the Spheres, V., 625; also 'Arcades.' We proceed now to notice the principal allusions to the heavenly bodies.

THE SUN.—Its beams are said to be magnetic, Paradise Lost, III., 583. Satan in the sun is thus described:—

"There lands the fiend, a spot like which perhaps
Astronomer in the sun's lucent orb
Through his glaz'd optic tube yet never saw."—III., 588, &c.

When the sun rose at the Creation,

———"the gray
Dawn and the Pleiades before him danc'd,
Shedding sweet influence."—VII., 373, &c.

This appears to refer to the heliacal rising of the Pleiades, at which time the sun's longitude is now about 80 degrees. Allowing, therefore, for precession, the sun would have been in Taurus at the vernal equinox at the vulgar epoch of the Creation; the moon being also full (see following verses). Milton, therefore, follows the common chronology.*

The sun's path is supposed to have been changed after the Fall:—

"Some say, he bid his angels turn ascanse
The poles of earth, twice ten degrees, and more,
From the sun's axle; they with labour push'd
Oblique the centric globe: some say, the sun
Was bid turn reins from th' æquinoctial road
Like distant breadth to Taurus, with the sev'n
Atlantic sisters, and the Spartan twins,
Up to the Tropic Crab; thence, down amain
By Leo, and the Virgin, and the Scales,
As deep as Capricorn; else had the spring
Perpetual smil'd on earth with vernant flow'rs," &c.
—X., 688, &c.

Speculations concerning the change of inclination of the earth's axis date from ancient times; and still have an attraction to some. Of course on the hypothesis of a miracle, it may have been changed, and may yet be again; and such a perpetual spring as the inhabitants of Jupiter (if there are any) enjoy, may be thus enjoyed on the earth too. Aug. Compte had the audacity to speculate on the advantages which would be derived, "if the combined efforts of the human race should ever permit us to readjust the axis of rotation of our globe on the plane of its orbit, provided that such an improvement were carried out with requisite wisdom." C. Flammarion, remarking that Compte could not have been serious in this idea, adds, "Everyone knows that we are upon the earth like ants upon the cupola of the Pantheon.*

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* Archbishop Ussher, however, fixes the first day of the world upon the entrance of the night preceding the twenty-third day of *October* (being our Sunday) B.C. 4004. Who is to decide?

Addison says (Spectator, No. 369), that, "from Adam's first appearance in the fourth book to his expulsion from Paradise in the twelfth, the author reckons ten days." Adam and Eve, however, had been sometime created before the fourth book (see IV., 449, 640, 680, 710; and in X., 327, &c., after the Fall, we find the sun rising in Aries, and Satan moving off at the opposite quarter of the heavens:—

"Satan in likeness of an angel bright,
Betwixt the Centaur, and the Scorpion steering
His Zenith, while the sun in Aries rose."

Which compared with VII., 373, already quoted, implies a full year elapsed.†

————"Whose orb
Thro' optick glass the Tuscan artist views
At ev'ning, from the top of Fesole,
Or in Valdarno, to descry new lands,
Rivers or mountains, in her spotty globe."—I., 287.

Raphael sees the earth at a distance,

"As when by night the glass
Of Galileo, less assur'd, observes
Imagin'd lands and regions in the moon."—V., 261, &c.

It is supposed to be inhabited:—

"Those argent fields more likely habitants,
Translated saints, or middle spirits hold,
Betwixt th' angelical and human kind."—III., 460, &c.

A moonlight night is described as follows:—

————"Now glow'd the firmament
With living saphirs; Hesperus, that led
The starry host, rode brightest; till the moon,
Rising in clouded majesty at length,
Apparent queen, unveil'd her peerless light,
And o'er the dark her silver mantle threw."—IV., 604, &c.

The morning and evening stars are mentioned, V., 166, &c.; 708, &c.; IX., 49; 'Lycidas'; and the phases of Venus, VII.. 366, &c.

STARS.—The polar star is called the

"Star of Arcady,
Or Tyrian cynosure."—Comus.

The Little Bear was regarded as the Arcadian maiden Kallisto. Cynosura (Kunos Oura), the Dog's Tail, is the same constellation; used by the Phœnicians in navigation.

In Paradise Lost, III., 557, &c., Satan surveys the compass of the heavens:—

——"From eastern point
Of Libra, to the fleecy star that bears
Andromeda far off Atlantic seas,
Beyond th' horizon."

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* "*La Pluralité des Mondes,*" *&c.*, p. 167.

† We have seen Dante's opinion about the space of time during which our first parents remained in Paradise. Adam did not continue more than half-a-day in Paradise, according to the opinion of the Musulmans, which in this is conformable to that of the Rabbins; but they explain that a day of the other world, or of Paradise, corresponds to a thousand of our years; therefore by that half-day must be understood 500 years (D'Herbelot, *Bibliotheque Orientale*, S. V. Adam). In the absence of positive information persons must adopt their own conclusions; but there can be little doubt which of these extreme views is nearer the truth.

The Moon.—The shield of Satan is compared to the moon in a familiar passage:—
The "fleecy star" is Aries. The stars are probably inhabited, III., 565-571; or destined to be:—

——"Every star perhaps a world
Of destined habitation."—VII., 621.

They shed a virtue on what grows on the earth, IV., 670, &c. The Almighty is represented as hanging forth in heaven:—

————"His golden scales, yet seen
Betwixt Astræa, and the Scorpion Sign."—IV., 997, &c.

Astræa of course is Virgo. The Milky Way is mentioned, VII, 579, &c:—

————"That milky way,
Which nightly, as a circling zone, thou seest
Powder'd with stars."

The Lady in "Comus," upbraids the Night for closing up in her dark lantern the stars—

"That nature hung in heaven, and fill'd their lamps
With everlasting oil, to give due light
To the misled and lonely traveller."

Falling Stars.—Uriel's gliding on a sun-beam was

————"Swift as a shooting star
In autumn thwarts the night, when vapours fir'd
Impress'd the airs, and shew the mariner
From what point of his compass to beware
Impetuous winds."—IV., 556, &c.

Satan is to fall from heaven—

————"Like an autumnal star,
Or lightning."—Paradise Regained, IV., near end.

The attendant spirit in Comus, says:—

"Swift as the sparkle of a glancing star
I shoot from heaven."

Mulciber, or Vulcan, thrown from heaven by Jove—

"Dropt from the zenith like a falling star."
—Paradise Lost, I. 745.

A few more particulars only, of a miscellaneous character, remain to be noticed. Milton understood the waters above the firmament of a supercelestial ocean:—

"The waters underneath from those above
Dividing: for as earth, so he the world
Built on circumflous waters calm, in wide
Crystalline ocean."—Paradise Lost, VII., 268, &c.

He seems to have regarded all the heavenly bodies as suffering from the effects of the Fall, Paradise Lost, X., 397-398, 410-414. The Star of the Magi is represented as "a star unseen before in heaven," XII., 360. This is much better than the fancy of Kepler, about a conjunction of Jupiter and Saturn,—a fancy taken up and worked out afterwards by Ideler. It was doubtless a luminous meteor miraculously prepared for the occasion. The subject is well and elaborately discussed in Smith's Dictionary of the Bible (*Star of the Wise Men*).

The telescope is once more alluded to in Paradise Regained, IV., near the beginning, when Satan in the Temptation shews our Lord the glories of Imperial Rome:—

"By what strange parallax, or optic skill
Of vision, multiplied through air, or glass
Of telescope, were curious to enquire."

Where "curious," means over-inquisitive. A few lines further on, Satan calls the contrivance his "airy microscope."

Other solar systems are hinted at:—

————"And other suns perhaps,
With their attendant moons, thou wilt descry,
Communicating male and female light."
—Paradise Lost, VIII., 148, &c.

Where "male and female light," refers to self-luminous bodies, and those which shine by reflected light; though Smyth (Cycle I., p. 301; Specul. Hart., p. 319) seems to understand by it also complementary colours.

Perhaps, on the whole, Milton could hardly have done better than he has, in the pretty fiction in which he describes the introduction of light. Paradise Lost, VII., 243, &c.:—

"Let there be light! said God: and forthwith light
Ethereal, first of things, quintessence pure,
Sprung from the deep: and from her native east,
To journey through the aëry gloom began,
Sphear'd in a radiant cloud:"

Probably the refinements of science will never lead to the full comprehension of the mystery of light, though far from being the deepest among the deep things which exercise the human mind. To the Voice that spake from the whirlwind more than 3000 years ago, and demanded, "Where is the way where light dwelleth? . . . Knowest thou it, because thou wast then born? or because the number of thy days is great?" (Job xxxviii. 19-21). Can we even now return an exhaustive reply? The name itself, in Hebrew, Ōr, is remarkable: "the oldest of all words; the first word ever recorded to have been pronounced" (see the interesting remarks of Sir John Herschel, in *Familiar Lectures on Scientific Subjects*, p. 219). If Milton here, as also in other instances, is at fault, it must be remembered that there is but one Book, which though written in periods of various antiquity, possesses with its other peerless excellencies, the characteristic of never being irreconcileable with science, though so often fearlessly touching its domain, in the language and figures of common life.

Such are the principal astronomical allusions which I have found in these four great poets; and the brief review of which, I trust, will not be unacceptable to the Hackney Scientific Association. As far as I know, there is no poem of modern date expressly dedicated to astronomy. Aratus and Manilius seem to have had no successors. And if there be truth in the assertions that "poetry and science are two rival and hostile powers," and "that it is impossible to treat any subject at once scientifically and poetically," we must not expect ever to see a superior astronomical poem; notwithstanding that the same person (as has been the case) may be both poet and astronomer. Still astronomical subjects have, doubtless, sometimes been clothed in 'creditable verse; and the heavens afford a better field than that chosen by Erasmus Darwin.' An astronomical poem that should reproduce the beauties of "*The Botanic Garden*," and avoid its frequent faults, may possibly sometime appear. A Dante or a Milton is not needed for this work; and by such as they (if such ever appear again) it would probably never be attempted. Is it too much to hope for an English Lucretius, without his Epicureanism and absurd views? What a work might the Roman poet have produced had he lived in our days! If indeed there should ever arise another like him, who shall consecrate to Urania that "marvellous ability and skill with which the most abstruse speculations and the most refractory technicalities have been luminously bodied forth in sonorous verse, and expressed in diction which, although full of animation and dignity, is never extravagant nor pompous,"* we shall possess something of more interest than the scattered allusions to which attention has been called in this paper; something that would deserve to be hung on the walls of our observatories in characters of gold, like the famous *Mu'allakāt*, or "suspended" poems of the Arabs, in their temple at Mecca.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

REFRACTORS AND REFLECTORS COMPARED.

Sir,—I send some particulars of a comparison made between a reflector and refractor of considerable size, under circumstances which were, in many respects, unusually favourable.

The instruments, a 7½ inch o.g., by Alvan Clarke, of 110-in. focus, formerly belonging to the Rev. W. R. Dawes; and a 9-inch speculum of silvered glass, 81-in. in focal length, are the property of Wentworth Erck, Esq., of Sherrington Bray, Co. Wicklow, who acted as one of the observers in making the comparison, and has kindly permitted the results to be made use of in drawing up this statement. We decided upon using two methods for ascertaining: 1st. The relative illuminating power, and 2nd, The defining qualities of the instrument compared.

The method first adopted was to direct the two telescopes, placed side by side, upon a distant terrestrial object, a black board bearing well-defined white marks, to which was attached a watch dial 1½ inch in diameter.

The appearance of these objects in the two instruments was carefully studied, with powers, first of 100 on both, then with 269 on the achromatic and 276 on the reflector, which latter instrument gave harder and better-defined outlines with its full apertures than the former did.

The relative illuminating power was tested by watching the gradual fading of the above-mentioned objects in the evening twilight, with the two telescopes armed with the eye-pieces previously employed for the comparison of defining power. With the full aperture of each in use, Mr. Erck considered that the object was sensibly of the same brightness in the two instruments, and that the refractor had the advantage in point of light, when the light receiving area of the reflector was reduced to an equality with that of its opponent.

In the first of the above cases the reflector appeared to me to have a slight but decided superiority, and in the second I was not able to determine which of the images was the brighter.

A great number of comparisons were made as long as the objects were visible, the eye being carried from one instrument to the other every two or three minutes, in regular alternation. A second series of comparisons was afterwards made when viewing celestial objects, both instruments being mounted equatorially, and provided with R.A. motion.

They were not more than 10 yards apart.

The objects selected were:

(1) 75 Cygni, dist. 2″.5,± pos. 322° mags. 4, 11. Dawes's scales.
(2) Lalande 42240, dist. 2″, pos. 105°± mags. 7½, 11. Dawes's scales.

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* William Ramsay, in Smith's *Dictionary of Greek and Roman Biography and Mythology*.

(3) γ Andromedæ.

(4) Saturn and the fainter satellites.

Full aperture of both instruments in use unless otherwise noted.

(1) Was beautifully shown by both instruments, with 100± on the reflector and 93± on the achromatic, the first showing the comet quite clear of the primary, the other exhibiting the pair in contact.

(2) Was well seen at moments with 250 on the refractor, and barely suspected with 150 and 300 (single lens) on the reflector.

(3) 540, a single lens, on the reflector showed me the discs divided at best moments with a dark space between them, but owing to unsteady air I could not see whether the discs were truly round or compressed on their approximated sides.

With a compound microscopic eyepiece, giving a power of about 800 on the achromatic, I was not able even to see the wedge notched, but the flaring of the image was at this time considerable.

The reflector appeared to give harder and sharper stellar discs than its opponent, with the power above quoted.

(4) Definition in both instruments extremely fine, steadier in the achromatic, but images otherwise undistinguishable.

3 faint satellites first seen by me with 150 on the reflector, at first seen by Mr. Erck with difficulty, using the achromatic armed with nearly the same power.

Afterwards we saw them distinctly with both instruments and power of 100 on each, and on reducing the apertures we found that the reflector showed the satellites with apparently greater intrinsic light than the achromatic, but that the field of the latter instrument was very perceptibly the darker of the two. Aperture 6·5-in. reflector, 5·25-in. achromatic.

We find the superiority in darkness of field when viewing a bright object to be always on the side of the achromatic, but the difference would, I believe, not be noticed except in a simultaneous comparison.

The silver film was not uniform in polish, being in many places somewhat cloudy.

The small mirror of the reflector was a 1¼-inch prism of very fine quality, and the disc which masked it was 1⅜-inch in diameter.

The results may be summed up briefly, that a refractor of given aperture will probably equal a reflector of one-seventh the greater aperture in illuminating power, but falls perceptibly below it in defining power.

It is probable also that the achromatic would be found to have the advantage in detecting faint objects in presence of a bright one, on account of its possessing apparently a slight advantage over its rival in blackness of field under similar circumstances.

It is possible that the deeper curvature of the lenses of a reflector's eyepieces, as compared with those giving the same power on an achromatic of similar diameter, but greater focal length, may account in part, at least, for the peculiarity referred to in the last paragraph. It was originally in contemplation to make a second series of comparisons between the two instruments, using one of Mr. Browning's beautiful flats in place of the prism before mentioned, but it has up to the present been found impracticable to carry out this intention.

I, therefore, venture to send you the above results, such as they are, in the hope that some of your readers who are interested in this question may possibly find them useful. It only remains for me to add that the method of comparing in daylight is due to the Rev. T. W. Webb (see *Register*, for 1869, p. 22), and with many apologies for the roughness of my notes, to remain, Yours truly,

Loughlinstown, Co. Dublin : CHARLES E. BURTON.
Nov. 13, 1872.

DISCOVERY OF THE PLANET VESTA.—IN REPLY TO J. S. G.

Sir, I have some recollections of having read somewhere that a *pupil* of Olbers discovered Vesta—perhaps it was in Arago's Lectures. No work, however, that I can refer to, makes any mention of this, and it seems irreconcilable with the details given by Delambre, (Astronomei 2. 555). Hind (Solar System), and Grant (History of Physical Astronomy, p. 241.)

Yours faithfully,
G. J. W.

ANCIENT ECLIPSES.

The following are the remaining eclipses mentioned in Ingram's translation of the *Saxon Chronicle*:—

A.D. 802.—"This year was the moon eclipsed at dawn, on the 13th day before the calends of January."

The full moon in December 801 was on the 23rd, and does not appear to have suffered eclipse; and at the full moons in December 800 and 802 there was no eclipse. That alluded to seems to be the eclipse of May 21, 802. Commencement about 2h. 20m. a.m., greatest phase, nearly total, 3h. 55m., about sunrise.

806.—"This year was the moon eclipsed on the 1st of September, Edwulf, king of the Northumbrians, was banished from his dominions, and Eanbert, bishop of Hexham, departed this life."

There was a total eclipse of the moon on the evening mentioned, lasting from about 8h. 25m. till after midnight. The total phase, according to these approximate tables, was from 9h. 37m. to 10h. 59m.

807.—"This year was the sun eclipsed precisely at eleven in the morning, on the 17th day before the calends of August."

The eclipse meant must be that of February 11th, that year three-fourths of the sun's surface were obscured about a quarter past ten.

897.—"A band of pirates assembled, and sat at Fulham by the Thames. The same year also was the sun eclipsed one hour of the day."

No month is given. I did not find any visible eclipse of the sun this year. On examining the previous year I found a great eclipse on October 29. According to the approximate tables I used, totality came on at London about 1h. 14m. which is very near the truth, as Mr. Hind has shown by a more recent and rigorous computation. Mr. Hind has informed me that the central line ran nearly over Carnarvon, Warwick, and Hertford. The north limit by Blackburn, Sheffield, and Boston. The south limit close to Cardigan, Westbury, and Worthing. In Struyk's Catalogue of eclipses, given in Ferguson's astronomy, this is put down as a large partial eclipse at Paris. It is doubtful whether there was any eclipse of the sun total at London from 878 till 1715.

904.—"This year the moon was eclipsed."

I find two total elipses of the moon, one on May 31, from 9h. 22m. to 13h. 5m., totality continuing 1h. 41m., the other on November 25th, from 7h. 25m. to 10h. 51m., totality lasting 1h. 11m.

1121.—"The moon was eclipsed on the night of the nones of April, being a fortnight old."

There was a total eclipse of the moon on the night of April 4th, beginning about 7h. 23m., and lasting till about 11h. 19m.

S. J. JOHNSON.

Upton Helions Rectory,
Crediton, Oct. 2.

MR. BIRD'S TRIPLE STAR IN DRACO.

Sir,—In the *Astronomical Register*, for Nov. 1869, Mr. F. Bird called attention to a new triple in Draco, near the planetary Nebula, 37 ♅ IV., and gave its approximate position. I have recently looked it up, and find its place for 1870 is as follows :—

Argelander (+ 67°) No. 1039, mag. 9·1. R.A. 17h. 52m. 57s. Dec. + 67° 1′·2.

This is not included in any of the catalogues of double stars. Mr. Bird gives the magnitudes as 8·9=9, and 11·8. The two brighter are about 25″ apart, the smaller being at equal distances from them on the line joining the two. This precedes the nebula 5m. 40s., its declination being 22′·9 greater. It is a rather singular looking object from the position of the small star, and well worth recording.

S. W. BURNHAM.

Chicago : Sept. 16.

NEW MULTIPLE STAR IN CASSIOPEA.

Sir,—I beg to call the attention of double-star observers to a new multiple star in Cassiopea, one of the most beautiful objects of its kind in the heavens. Its catalogue place for 1870 is as follows:—

Argelander (+55°) No. 191. Mag. 7·7. R.A., 0h. 45m. 12s.
Dec. + 55° 55′

This was discovered as a triple, Sept. 12th, 1871, and noted in a letter in the *English Mechanic*, of Nov. 24th. While looking for another object, Sept. 14th, 1872, I picked it up, and saw at once that the brightest star of the triple was a close double, and that there was a very minute star to the north of the primary not before noticed. As a triple it is quite an easy object, and singularly overlooked by former observers. Having observed the close companion but once, I am not able to speak very positively of its difficulty. On this occasion I saw it very readily with my 6-in. refractor, and was surprised at having missed it before. I can only account for it by supposing the atmosphere at that time was unsteady, or only moderately good. The last observation, however, was made under very favourable circumstance. Among other doubles found and afterwards identified, was the close pair of P. XX. 178 in Delphinus, discovered by Dawes, the distance of which is but 0″·5. This is a more difficult object than γ^2 Andromedæ. I compared the close pair of the triple with Dawes' close pair in P. XXIII. 101, Cassiopea, and found the distance was about the same, and with no great difference in difficulty, Dawes' being, perhaps, a little the easiest. He gives the distance as 1″·5.

The estimated distances, positions, and magnitudes, are as follows :—

A and B.	P=90°·	D=1″·5	M=7¾ 11
A and C.	135·	4·	8½
A and D.	200·	10·	10
A and E.	360·	15·	15

As will be seen the companions are somewhat curiously arranged around the principal star, the angles increasing with the distances. With the single exception of the trapezium of Orion, I do not know of a more elegant object. The stars B and E are the most accurately found. There are two small stars preceding the group, as well as others more distant in the same field. For the benefit of those not provided with an equatorial mounting, I may add that to find this object it is only necessary to place the instrument upon *α* Cassiopea, and wait 12m. 4s., and this star will be found in the field, the declination of the two differing but 5′ 43″.

S. W. BURNHAM.

Chicago, Sept. 16th.

PROFESSOR P. SMYTH ON THE HARVEST MOON.

Sir,—Having just received from some one unknown, a copy of your issue of October 15, I find my attention called therein to a letter signed "Sabreur," demanding either a criticism of a certain Dr. Duncan's description of the harvest moon, or a new account thereof.

Now the harvest moon has been so abundantly explained and commented on in dozens of popular astronomy books during the last hundred years, that any man who can read has only to go to a library and find all the facts of the case in print, both ready to his hand and meet for the instruction of his mind. But knowledge for science's sake alone is unhappily far from the thoughts of "Sabreur," whose letter too surely betrays something else first—*i.e.*, that the unfortunate Dr. Duncan having ventured to come, with some innocent enough and not very new notions on final causes, between the wind and "Sabreur's" decidedly rationalistic nobility, "Sabreur" immediately mounts the high horse of the daily press, and, flourishing his ugly weapon of murder over his head, invokes all and sundry of the present age, but specially practical astronomers, to join with him in cutting and hacking at, in slashing, plunging, and slaying a poor solitary wretch who has been caught in the very fact of writing, and under his own proper name, the thing which is odious to modern infidelity.

And what have I, as a practical astronomer so called upon, got to say in the matter? Why, this:

(1.) Excepting some verbal inaccuracies, Dr. Duncan gives a fair account of the well-known fact that when any full moon occurs on or near the 21st of September the three or four nights immediately following have in our latitudes earlier and longer continued moonshine than the similar nights following any other full moon throughout the year—the phenomenon varying slightly from year to year, but being substantially as above.

(2.) If the farmers, as avouched by Dr. Duncan, have not only perceived that fact under the name of the harvest moon, but are also thankful to God for the use they are enabled to make of it, they do well, though they might do more. They might, for instance, join with astronomers who see in the celestial mechanics producing the harvest moon phenomenon a happy appendix or corollary to those grander arrangements which have both given rotation to the axis of the earth, and placed that axis at a large angle to the plane of the earth's orbit round the sun—arrangements without which the alternations of day and night, and summer and winter, so necessary to the life and labours of man, could not be. And when these arrangements are also found to be so nicely bound up with others more special still, deciding the size of the earth's orbit, its distance from, and degree of heating by, the sun as best adapted to any abode appointed for man—together with the external and internal constitution of our globe, not merely as to air and water for animal life, but also as to the wondrous chemical elements from which man now draws so abundantly the means of material power and exalted usefulness—why, then, the devout astronomer not only treads in the steps of the farmer, so far as he goes, but further still—prays thankfully and with all the positive instruction of revelation, to God the Father, the Son, and the Holy Ghost, of whom, if in mere chronological sequence, it can hardly be said that He created all these things *for man*, yet He created man so suitably *for them*, and with such wonderful wisdom foreseeing every detail, that we need no longer be in any difficulty at the inspired statement, that no hair of our head can fall unheeded by Him, and no passing word be uttered by us unnoted above and unregistered for future account!

Wherefore the sooner this vindictive "Sabreur" turns his bloodthirsty and would-be destroying blade into a peaceful pruning-hook, and strives in purity of heart and openness of name to cultivate friendly relations with those who are enabled to see God in small things, as well as great, the better for him both here and hereafter.

C. PIAZZI SMYTH,
Astronomer Royal for Scotland.

Royal Observatory,
Edinburgh: October 19, 1872.

—Dundee Advertiser.

SUN.

Greenwich, Noon. 1872.		Heliographical western longitude of the centre		Heliographical latitude of the sun's disc.		Angle of position of the sun's axis.	
		°	°	°		°	
Dec. 1	...	7·30	13·19	+0·54	—·13	15·80	—·39
2	...	20·49	13·19	0·41	·12	15·41	·41
3	...	33·68	13·20	0·29	·13	15·00	·41
4	...	46·88	13·19	0·16	·13	14·59	·41
5	...	60·07	13 19	+0·03	·13	14·18	·42
6	...	73·26	13·19	—0·10	·13	13·76	·42
7	...	86·45	13·20	0·23	·13	13·34	·43
—							
8	...	99·65	13·19	—0·36	—·12	12·91	—·43
9	...	112·84	13·19	0·48	·13	12·48	·44
10	...	126·03	13·19	0·61	·13	12·04	·44
11	...	139·22	13·19	0·74	·13	11·60	·45
12	...	152·51	13·19	0·87	·12	11·15	·45
13	...	165·80	13·19	0·99	·13	10·70	·46
14	...	178·89	13·19	1·12	·13	10·24	·46
—							
15	...	191·98	13·19	—1·25	—·12	9·78	—·46
16	...	205·17	13·19	1·37	·13	9·32	·46
17	...	218·36	13·19	1·50	·13	8·86	·47
18	...	231·55	13·19	1·63	·12	8·39	·47
19	...	244·74	13·19	1·75	·12	7·92	·47
20	...	267·93	13·19	1·87	·13	7·45	·48
21	...	271·12	13·18	2·00	·12	6·97	·48
—							
22	...	284·30	13·19	—2·12	—·12	6·49	—·48
23	...	297·49	13·19	2 24	·13	6·01	·48
24	...	310·68	13·19	2·37	·12	5·53	·49
25	...	323·87	13·18	2·49	·12	5·04	·48
26	...	337·05	13·19	2·61	·12	4·56	·49
27	...	350·24	13·18	2·73	·12	4·07	·49
28	...	3·42	13·19	2·85	·12	3·58	·49
—							
29	...	16·61	13·19	—2·97	—·11	3·09	—·48
30	...	29·80	13·18	3·08	·12	2·61	·49
31	...	42·98		3·20		2·12	

Assumed daily rate of rotation, 14°·20.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN DEC., 1872.

By W. R. Birt, F.R.A.S., F.M.S.

On September 17, 1871, the value of supplement ☾ — ☉ was 138° 15'·1 (see vol. ix., p. 217.) On November 15, 1871, the value was 134° 24'·9 (see vol. ix., p. 270.) On December 3, 1872, the value is 136° 30'·4. The lists for September and November, 1871, may therefore be consulted for objects suitable for observation in December, 1872.

Twelfth Zone of objects from North to South, 20° *to* 25° *W. long.*

Meton (the west part), Mrs. Somerville (*a*), Posidonius γ (*b*), Plinius,* Ross,* Manners (*c*), Sabine, Hypatia, Cyrillus, Catharina, Polybius, Pons,* Zagut,* Lindenau,* Rabbi, Levi,* Büsching, Schomberger (the east part).

Objects marked thus (*) have not been mentioned in the monthly lists.

(*a*) A conspicuous crater N.W. of Aristoteles marked B by Beer and Mädler. It was named by the late Dr. Lee to commemorate the scientific works of Mrs. Somerville.

(*b*) This mountain is interesting on account of its presenting similar phenomena to Linné, and especially so as the two objects are exceedingly different the one from the other. In both a small orifice can be detected with large apertures, and as the sun rises high upon them they are at the present epoch surrounded and covered by a white spot exceeding them in size. In connection with these white spots attention may be called to a large white spot, west of Picard, in the Mare Crisium, which was constantly observed between 1859 and 1863 or later, but has recently not been seen of its former extent It is now much smaller.

(*c*) A conspicuous crater between Arago and Ritter marked A by B and M. It has been named Manners in commemoration of a late president of the Royal Astronomical Society.

As portions of Zones 11 and 12 pass through the Mare Serenitatis, it would be well to observe and compare them with the monogram, especially as they contain objects suspected of having undergone change. The Zones may be advantageously examined between five and seven days of the moon's age.

Season.—Autumn in the northern hemisphere. North pole in darkness. The sun crossed the moon's equators on Nov. 24. Objects in high northern latitudes may be well studied on the 5th, 6th, and 7th.

In the list for October attention was called to the fact that the further prosecution of observation of variation of tint on the moon's surface was left entirely in private hands, and the region S.S.E. of the Mare Serenitatis was pointed out as a very suitable one for observations of the same kind as those of Plato. During the months of August, September, and October, as many as seventeen separate objects have been brought under observation, embracing an extent of tint varying from 0·24 to 0·70 of the Plato scale, or that employed in the discussion of the Plato observations which, from a careful comparison, with the tints of the general scale deduced from those used by Schröter, Zohrmann, and Bandell, is equal to a range of 3°.75 on the general scale, the zero of which is black shadow and the upper limit 10° which represents the brightest object on the moon's surface—the central mountain of Aristarchus. In the observations August to October the darkest observed tint of Plato was 0·70, or a little darker than 1°·25 of the general scale. The lightest was 0·40 or nearly 3°·75 of the general scale. During the three months Zohrmann's Boscovich varied to the extent of 0·06 only, or 0°·5 of the general scale, Darkest 0·66 = 1·5, lightest 0·60 = 2°·0 the variation of Plato during the same period was 2°·5.

Plato Scale	0·66	0·60	0·54	0·48	0·42	0·36	0·30	0·24.
General Scale	1·5	2°·0	2°·5	3°·0	3°·5	4°·0	4°·5	5°·0.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sun	1	 9 58 19 43	Sidereal Time at Mean Noon, 16h. 42m. 35·82s. Conjunction of Mars and η Virginis (3·1m) Conjunction of Moon and Mercury 0° 35′ N.	**1**st Sh. I. **1**st Tr. I. **1**st Sh. E. **1**st Tr. E.	14 34 15 48 16 54 18 8	Aldebaran. — 11 44·1
Mon	2	21 3	Conjunction of Moon and Venus, 1° 41′ N. Saturn's Ring: Major Axis = 34″·82 Minor Axis = 14″·08	**1**st Ec. D. **2**nd Oc. R. **1**st Oc. R.	11 53 50 13 25 15 25	11 40·2
Tues	3	0 4	Conjunction of Moon and Saturn 3° 47′ N. Sun's Meridian Passage, 9m. 47·91s. before Mean Noon	**1**st Sh. E. **1**st Tr. E.	11 23 12 36	11 36·2
Wed	4	12 53	Conjunction of Saturn and Venus, 2° 0′ S.			11 32·3
Thur	5					11 28·4
Fri	6	23 36 8 3 9 9 9 24 10 14	☽ Moon's First Quarter Occultation of τ^1 Aquarii (6) Reappearance of ditto Occultation of τ^2 Aquarii (4) Reappearance of ditto			Moon. — 5 32·6
Sat	7			**3**rd Sh. E. **3**rd Tr. I. **2**nd Sh. I. **4**th Ec. D. **3**rd Tr. E. **2**nd Tr. I. **2**nd Sh. E. **1**st Ec. D.	13 28 14 38 16 8 18 11 59 18 19 18 38 19 4 19 18 35	6 22·9
Sun	8			**1**st Sh. I. **1**st Tr. I. **1**st Sh. E.	16 28 17 40 18 48	7 10·4
Mon	9	3 22 4 26 7 16 8 9	Occultation of 35 Ceti (6½) Reappearance of ditto Occultation of *f* Piscium (5½) Reappearance of ditto	**2**nd Ec. D. **2**nd Oc. R. **1**st Oc. R.	13 46 50 15 57 17 16	7 56·6
Tues	10			**1**st Sh. I. **1**st Tr. I. **1**st Sh. E. **1**st Tr. E.	10 56 12 8 13 16 14 28	8 42·5
Wed	11			**2**nd Tr. E. **1**st Oc. R.	10 44 11 44	9 29·3
Thur	12	15 23	Near approach of B.A.C. 1242 (6)			10 17·7
Fri	13					11 7·9
Sat	14	9 44	○ Full Moon	**3**rd Sh. I. **3**rd Sh. E. **3**rd Tr. I. **2**nd Sh. I.	13 42 17 25 18 24 18 42	11 59·7
Sun	15	22 55 19 4 20 20 21 9	Inferior conjunction of Mercury Conjunction of Moon and Uranus 4° 4′ S. Illuminated portion of disc of Venus = 0·780 Illuminated portion of disc of Mars = 0·913 Occultation of 37 Geminorum (6) Reappearance of ditto	**1**st Sh. I. **1**st Tr. I.	18 21 19 30	12 52·0

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Moon. —
Mon	16	18 45 19 14	Occultation of κ Geminorum (3½) Reappearance of ditto	4th Tr. I. 2nd Ec. D. 1st Ec. D. 4th Tr. E. 2nd Oc. R. 1st Oc. R.	13 28 13 13 49 15 39 51 17 15 18 26 19 6	13 43·8
Tues	17		Sidereal Time at Mean Noon, 17h. 45m. 40·76s.	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	12 49 13 58 15 19 16 18	Aldebaran. — 10 41·2
Wed	18		Sun's Meridian Passage, 2m. 55·32s. before Mean Noon	2nd Tr. I. 2nd Sh. E. 3rd Oc. R. 2nd Tr. E. 1st Oc. R.	10 17 10 53 12 5 13 10 13 33	10 37·3
Thur	19	22 37 13 34 14 51	Conjunction of Moon and Jupiter, 4° 31′ S. Occultation of η Leonis (3½) Reappearance of ditto	1st Sh. E. 1st Tr. E.	9 38 10 45	10 33·3
Fri	20					10 29·4
Sat	21			3rd Sh. I.	17 40	10 25·5
Sun	22	14 11	☽ Moon's Last Quarter Saturn's ring: Major axis=34″·31 Minor axis=13″·56			10 21·5
Mon	23	15 28	Conjunction of Moon and Mars, 2° 23′ S.	2nd Ec. D. 1st Ec. D.	15 49 55 17 32 53	10 17·6
Tues	24	20 54	Conjunction of Mars and θ Virginis 0·4m. S.	4th Ec. D. 1st Sh. I. 1st Tr. I. 4th Ec. R. 1st Sh. E. 1st Tr. E.	12 10 37 14 43 15 47 16 55 56 17 4 18 6	10 13·7
Wed	25	4 58	Conjunction of Mars and θ Virginis (0·6m.) W.	2nd Sh. I. 3rd Ec. R. 1st Ec. D. 3rd Oc. D. 2nd Tr. I. 2nd Sh. E. 1st Oc. R. 2nd Tr. E. 3rd Oc. R.	10 31 11 26 35 12 1 12 3 12 40 13 26 15 21 15 33 15 43	10 9·7
Thur	26	15 54 16 53 17 25 18 30	Occultation of 41 Libræ (6) Reappearance of ditto Occultation of κ Libræ (5) Reappearance of ditto	1st Tr. I. 1st Sh. E. 1st Tr. E.	10 14 11 32 12 33	10 5·8
Fri	27			1st Oc. D. 2nd Oc. R.	9 48 10 5	10 1·9
Sat	28	7 8	Conjunction of Moon and Mercury, 4° 5′ N.			9 57·9
Sun	29	18 36	● New Moon			9 54·0
Mon	30	14 31	Conjunction of Moon and Saturn, 3° 54′ N.	2nd Ec. D. 1st Ec. D.	18 26 7 19 25 58	9 50·1
Tues	31			1st Sh. I. 1st Tr. I. 1st Sh. E.	16 37 17 35 18 57	9 46·1

THE PLANETS FOR DECEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m
Mercury ...	1st	18 3 0	—25 26	7″·2	1 20·2
	15th	17 45 36 17 37 46	—21 43 —21 22½	9″·8	0 5·8 23 56·0
Venus ...	1st	19 4 29	—24 33½	13″·1	2 21·5
	15th	20 7 33	—24 18	14″·9	2 39·5
Mars ...	1st	12 17 17	— 0 15½	6″·2	19 31·5
	15th	12 45 33	— 2 59	6″·8	19 4·6
Jupiter ...	1st	10 14 0	+11 56	36″·3	17 28·5
	15th	10 15 26	+11 52	37″·7	16 34·9
Uranus ...	14th	8 31 45	+19 31	4″·2	7 54·9
Neptune ..	2nd	1 30 43	+ 7 36		8 42 8
	14th	1 30 4	+ 7 33		7 54·9

Mercury sets more than an hour after the sun at the beginning of the month, the interval decreasing after the 15th. On and after, he is a morning star rising at the end of the month nearly two hours after the sun.

Venus is well situated for observation for some time after the sun. sets, the interval increasing from 2h. at the beginning of the month to 3½h. at the end.

Mars may be seen about 1½h. after midnight, the interval decreasing to an hour at the end of the month.

Jupiter is in a good position for observation, rising 2h. before midnight at the beginning of the month, the interval increasing to about 4h, on the 31st.

Uranus may be seen well throughout the night.

Neptune is well situated for observation.

MOON.

LIBRATION. SUN'S PLACE.
Selenographical colong. and lat. of the point on the moon's surface which has the *Earth's* | *Sun's* centre in the zenith.
Greenwich midnight.

TERMINATOR.
Selenographical colong. of the points in latitude 60° N., 0° and 60° S., where the sun's centre rises or sets.

	colong.	lat.	colong.	lat.		60° N.	0°	60° S.
1872.	°	°	°	°	°	°	°	°
						SUNRISE.		
Dec. 6	86·21	+6 78	350·07	+12·16	—0·32	79·5	80·1	86·0
7	85·35	6·41	2·23	12·15	0·35	91·6	92·2	92·8

8	84·74	+5·68	14·38	12·15	—0·38	103·7	104·4	105·1
9	84·39	4·65	26·53	12·14	0·41	115·8	116·5	117·2
10	84·31	3·38	38·67	12·14	0·44	127·9	128·7	129·4
11	84·47	1·96	50·81	12·13	0·47	140·0	140·8	141·6
12	84·84	+0·46	62·94	12·13	0·50	152·1	152·9	153·8
13	85·52	—1·04	75·07	12 12	0·53	164·2	165·1	166·0
14	86·19	2·47	87·19	12·13	0·56	SUNSET.		
—								
15	87·10	—3·75	99·32	12·13	—0·59	10·3	9·3	8·3
16	88·16	4·85	111·45	12·13	0·62	22·5	21·5	20·4
17	89·34	5·73	123·58	12·14	0·65	34·7	33·6	32·5
18	90·59	6·35	135·72	12·14	0·68	46·9	45·7	44·6
19	91·88	6·69	147·86	11·14	0·70	59·1	57·9	56·7
20	93·16	6·74	160·00	12·15	0·73	71·2	70·0	68·8
21	94·36	6·51	172·15	12·16	0·75	83·4	82·2	80·9
—								
22	95·43	—5·99	184·31	12·16	—0·78	95·6	94·3	93 0
23	96·25	5·18	196·47	12·17	0·80	107·8	106·5	105·1
24	96·80	4·10	208·64	12·17	0·82	120·1	118·6	117·2
25	96·98	2·78	220·81	12·18	0·84	132·3	130·8	129·4
26	96·74	—1·27	232·99		—0·86	144·5	143·0	141·5

Colong. = 90° —λ.

The following table furnishes for a score of lunar spots, the co-longitudes of the sun's centre at the times of its passing the true horizon of the spots, or when its zenith distance is 90°.

Sun's Selenogr. Latitudes :

	—1°.50	—1°.00	—0°.50	0°.00	+0°.50	+1°.00	+1°.50
Sun's Co-longitudes at Sun-rise:							
	°	°	°	°	°	°	°
Posidonius A	331·80	331·49	331·18	330·88	330·57	330·26	329·95
Theophilus	333·39	333·49	333·60	333·70	333·80	333·90	334·00
Plinius... ...	347·02	346·88	346·75	346·61	346·47	346·34	346·20
Maurolycus	344·90	345·38	345·85	346·32	346·79	347·26	347·74
Linné	349.25	348·99	348·72	348·46	348·19	347·93	347·67
Manilius ...	351·60	351·48	351·35	351·22	351·09	350·96	350·83
Aristillus ...	359·98	359·66	359·32	358·99	358 65	358·32	357·99
Mösting A ...	5 14	5·17	5·20	5·22	5.25	5·28	5·31
Pico	10·73	10 23	9 72	9·21	8·70	8·19	7·68
Eratosthenes .	11 83	11·70	11·57	11·44	11·31	11·18	11·05
Tycho	10·48	10·95	11·41	11·87	12·34	12·80	13.27
Timocharis .	13·75	13·50	13 25	13·00	12·74	12·49	12·24
Clavius C .	12·34	13·12	13·90	14 67	15·45	16 23	17·01
Copernicus .	20·18	20·09	20·01	19·93	19·85	19·77	19·68
Laplace A .	27·97	27·50	27.03	26.56	26·09	25.62	25·15
Ramsden .	30·75	31·06	31·38	31 70	32·02	32·33	32·65
Heraclides ...	35·33	34·90	31.46	34·02	33.59	33·15	32·71
Kepler	37·91	37·84	37·77	37·71	37·64	37·57	37·50
Gassendi A ...	39·07	39.22	39·38	39 53	39·68	39·83	39·98
Aristarch ...	47·85	47·63	47·42	47.20	46·99	46·77	46·56
At Sunset :							
Posidonius A	149·95	150·26	150·57	150·88	151·18	151·49	151·80
Theophilus	154·00	153·90	153·80	153·70	153·60	153·49	153·39
Plinius ...	166·20	166·34	166·47	166·61	166·75	166 88	167·02
Maurolycus	167·74	167·26	166·79	166·32	165·85	165·38	164·90

Linnè... ...	167·67	167·93	168·19	168·46	168·72	168·99	169·25
Manilius ...	170·83	170·96	171·09	171·22	171·35	171·48	171·60
Aristillus ...	177·99	178·32	178·65	178·99	179·32	179·66	179·98
Mösting A ..	185·31	185·28	185·25	185·22	185·20	185·17	185·14
Pico	187·68	187·19	188·70	189·21	189·72	190·23	190·73
Eratosthenes.	191·05	191·18	191·31	191·44	191·57	191·70	191·83
Tycho... ...	193·27	192·80	192·34	191·87	191·41	190·95	190·48
Timocharis...	192·24	192·49	192·74	193·00	193·25	193·50	193·75
Clavius C ...	197·01	196·23	195·45	194·67	193·90	193·12	192·34
Copernicus...	199·68	199·77	199·85	199·93	200·01	200·09	200·18
Laplace A ...	205·15	205·62	206·09	206·56	207·03	207·50	207·97
Ramsden ...	212·65	212·33	212·02	211·70	211·38	211·06	210·75
Heraclides ...	212·71	213·15	213·59	214·02	214·46	214·90	215·33
Kepler ...	217·50	217·57	217·64	217·71	217·77	217·84	217·91
Gassendi A .	219·98	219·83	219·68	219·53	219·38	219·22	219·07
Aristarch ...	226·56	226·77	226·99	227·20	227·42	227·63	227·85

To find the time of the Sun's centre passing the true horizon of Linnè on December 6, the sun's selen-latitude being 0°.32, the corresponding co-longitude is found, by interpolation between the 3d and 4th values in the line for Linnè, to be 348·63. According to the monthly list, sun's centre is in this co-longitude on December 6, about 10m. past 9h. But how much sooner or later becomes Linnè visible to us ?

At Tacherent in the most recent Russian territorial acquisition in Central Asia, the government is about to erect an astronomical observatory, to which will be added an establishment for magnetic and meteorological observations. The buildings are to be commenced immediately.—*Standard.*

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Aug., 1872.
Darby, Rev. W. A.

To Sept., 1872.
Coulcher, M. W. B.

To Oct., 1872.
Hill, C.

To Nov., 1872.
Seccombe, Dr.

To Dec., 1872.
Benson, Rev. R. W.
Cooke, T. E.
Elliott, R.
Jenkinson, Rev. J. B.
Lemmon, G. F.
Wright, Rev. W. B.

To March, 1873.
Mills, E. B.

To June, 1873.
Compton, A. J. S.
Potter, Thos.

To Aug., 1873.
Matthews, W. P.

To Dec. 1873.
Simkiss, T. M.

TO CORRESPONDENTS.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

We are obliged to postpone Professor Donati's Address and other interesting matter for want of space.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, Hackney Collegiate School, *Clarence Road, Clapton, E.*, **not later than the 15th of the Month.**

APPENDIX.

REPORT OF THE OBSERVING ASTRONOMICAL SOCIETY.

OBSERVATIONS MADE BY THE MEMBERS.

Solar Phenomena.—Mr. T. G. E. Elger, F.R.A.S., reports that "on August 19 many large scattered groups of spots were observed. The most remarkable of them measured, at 3h., about 2′ 56″ in extreme length: the penumbra, which was very irregular in shape, contained upwards of one hundred small black spots. During the month of September no large groups were remarked. On the 7th the sun was quite free from spots, with the exception of four small punctures without penumbræ; and on the 18th the large groups of August 19 had diminished to such an extent that they were scarcely deserving of notice. The portion of the sun's disc which had been occupied by the large spot of August 19 was near the W. limb on September 17, and was observed to be of an intensely brown colour; this appearance was frequently remarked in connection with the large groups of last year." Mr. T. W. Backhouse writes:—"My only September observation of the sun worth mentioning is that, on the 20th, when there was a largish spot on the middle of the S. zone, its umbra was of a singular shape; at 3h. 10m. it was 23,000 miles long, but half the length consisted of a very narrow, straight projection, and it was 9,500 miles wide. Its penumbra was only 29,000 miles long.

Meteors.—On September 10, 7h. 4m., "while daylight was too strong for the visibility of any stars," the Rev. S. J. Johnson, of Crediton, witnessed the appearance of a meteor of considerable brightness. He says, "It started about 25° above the S. horizon, and after taking a diagonal course ended at an altitude of about 10°. It continued in sight about 5 seconds." The meteors of August were well observed by Mr. E. Neison, of London, who, with the assistance of two friends, obtained the following results:—

METEORS SEEN.

Date.	Time of Obs.	Duration of Obs. m.	Very bright.	Bright.	Total.	Number per hour.
Aug. 6	9.50 to 10.47	49	2	4	15	18
7	8.58 to 10.35	97	4	13	43	27
8	9.45 to 10.18	33	2	9	29	53
9	9.5 to 10.21	86	5	16	62	43
10	10.7 to 10.58	51	4	27	90	106
11	Cloudy, clear for a brief interval.	5	1	—	2	24
12	9.55 to 10.26	31	3	7	20	39
13	9.0 to 9.56	56	2	8	25	27
	Total	6h. 48m.	23	84	286	Avg. 42

Mr. Neison remarks that the total observable meteors were without doubt over 500, as only about one-half of the sky was kept under view.

Cotham Park, Bristol:
November 7, 1871.

WILLIAM F. DENNING,
Hon. Sec.

Aurora Borealis.—On the evening of November 9, Mr. William F. Denning observed a very interesting, though not very grand, exhibition of the Aurora Borealis. He first noticed the phenomenon at 7h. 30m., when there was a large arch of auroral light extending from places about 45° east and 45° west of the northern horizon, and passing just below Beta Aurigæ, through Ursa Minor, over the star Gamma, and on through the head of Hydra, enveloping the stars Beta and Gamma in that constellation. The light was most intense in the N.W. and N.E. Many changes were apparent in the intensity of this arch, and it soon appeared to be broken, and gradually became fainter, until at 7h. 57m. all traces of it were gone. I noticed no streamers at all, but at the time when the phenomenon was at its best, an intense glow was suffused over the northern horizon. Much later in the evening, and indeed throughout the greater portion of the night, this glow was still apparent through breaks in the stratus clouds that were situated in proximity to the northern part of the horizon.

The Nebula in the Pleiades in Taurus.—Mr. Albert S. Holden reports that "with good eyesight and a clear atmosphere I have failed to find the slightest traces of the nebula on all occasions; I have, therefore, no hesitation in saying that in instruments of 3-in. aperture and under this object is utterly invisible. I beg some members of the Society to search for this object with larger instruments, so that the question as to its actual disappearance may be beyond dispute. It is important that this question should be set at rest at once, because in the event of the nebula brightening we should certainly regret not having decisively established the fact of its disappearance." There are several well authenticated instances of change noticed in regard to some of the nebulæ, and it is very advisable the object spoken of above should be very carefully looked for by those who possess telescopes of greater power than Mr. Holden.

HACKNEY SCIENTIFIC ASSOCIATION.—At the First Ordinary Meeting of the Fifth Session, held on November 14, a large audience assembled to hear a paper by the distinguished selenographer, Mr. W. R. Birt, F.R.A.S., V.P. of the Association, "On the Progress of Selenography during the last Half Century."

Mr. Birt, taking as his starting point the year 1821, remarked that previous to that epoch few observers had devoted much attention to the description of detail of the moon's surface. We have, he said, some good drawings of Bianchini, and a valuable series by Schröter, which, with the letterpress of his "Selenotopographische Fragmente," constitute an important store of facts for continual reference. It was about the commencement of the last half century that Lohrmann took up selenographical work, and produced in the year 1824 four of his sections on a connected scale, which in this respect differs materially from Schröter's plan. He also introduced what may be termed the "German style," by attempting to depict hypsometrical and chromatic relations by a species of contouring and shading. Perhaps in the latter he has been the most successful, because in the absence of anything like a *datum level* on the moon, and the large scale that is necessary for delineating relative contours, an attempt to depict relative heights must be unsatisfactory. Nevertheless, his sections contain most valuable information, and have certainly contributed to the advancement of our knowledge. The great feature of the half century is, undoubtedly, the production of the large German Map, a monument of the skill and industry of its authors, Beer and Mädler. The accurate determination of points of the first order, the approximate position of points of the second order, the accompanying letterpress "Der Mond," containing an admirable introduction to selenography, with records of observations, measurements, and formulæ, render it desirable that its perusal and study should not be restricted to German scholars, but that it should appear in an English dress. So small a portion of the attention of physicists had previously been devoted to lunar subjects, that the great work of Beer and Mädler was considered as well nigh exhaustive; in fact, there was at that time scarcely an astronomer who could or would have immediately followed up, with the energy and perseverance of the authors, a work but little understood, if we except the present Director of the Observatory at Athens, Julius Schmidt. The consequence has been a retardation of progress; for we find nothing of any moment published as illustrative of selonography between the years 1836 and 1852, when the British Association appointed a Committee for obtaining drawings of conspicuous objects, with a view to determine the effects of light upon the appearances as seen at morning, midday, and evening; and also to ascertain the relations existing between the ejected matter of the so-called craters and surrounding ramparts, supposing them to have been produced by falling ejected matter from the central orifice. In connection with this Committee three views of the Mare Crisium were published by Professor C. Piazzi Smyth, and drawings made of the walled plains Plato and Gassendi, by Professors Challis and Philip.

In the year 1856 Julius Schmidt published his "Der Mond," an interesting and useful work, containing comparisons between terrestrial and lunar forms, with sections, and other important information. This work is not much known in this country, and Mr. Birt remarked, in passing, that the small share in selenographical discovery which had fallen to English astronomers, may be attributed to the paucity of works on the physical features of the moon's surface, in the English language. Had a digest, in English, of the principal German works appeared, no doubt attention to a much greater degree would have been given to the moon. Three years later than the publication of Schmidt's work, the Rev. T. W. Webb's "Celestial Objects for Common Telescopes" appeared, and there can be little doubt that this unpretending volume has contributed in no small degree to create an interest in lunar studies; containing as it does an excellent index map, a catalogue of named objects, and several most interesting notices of the larger formations. An immediate consequence of this portion of Mr. Webb's work was the contrivance of a method by which every object on the moon's surface may be permanently registered; and in the year 1863 a register of lunar objects was commenced. In order to carry out the plan more extensively, a Committee was appointed in the year 1864 by the British Association to superintend the registration, and to map on a large scale the objects observed in its progress. This Committee has mapped three areas of 25 square degrees each, and a fourth has since been issued by private subscription. In addition, two monograms have been issued; one of the *Mare Serenitatis*, the other of Hipparchus. The number of objects at present registered is about 2,000, and nearly 500 are named up to the period of the commencement of this work; the study of the moon treated more as a whole, but it is now beginning to be understood that for real progress the separate study of selected portions is necessary, and amateurs are steadily at work—some in studying the larger craters, others the minute objects, clefts, etc.; and others are engaged in adding to the objects already registered. Should the mode of registration be generally adopted, it will add greatly to the precision of our knowledge of the moon's surface.

The paper closed with a reference to the author's discussion of the observations of Plato, as illustrative of the advantages to be derived from the careful study of a single object, not only as to a knowledge of its principal features, but also of those agencies which have contributed to mould and modify those features; and in expressing a hope that we are now on the eve of becoming acquainted with changes in those features that are evidences of still existing activity, either of a volcanic or meteorological character, or possibly of both.

The paper was listened to with marked interest and attention; and at its close a cordial vote of thanks was moved to the eminent lecturer.

APPENDIX.

REPORT OF THE OBSERVING ASTRONOMICAL SOCIETY.

OBSERVATIONS MADE BY THE MEMBERS.

Jupiter.—Mr. H. W. Hollis, of Newcastle, Staff., reports that on January 14, 9h, the disc of the planet appeared very sharp, and he counted 22 different bands of colour. "Those visible in the equatorial parts of a beautiful delicate pinky brown. I am certain that the belts are visible up to the very edges of the disc, but there is an apparent increase of brightness for a considerable distance round the edge of the planet, probably an effect of contrast, which obliterates the extremities of the belts unless carefully looked for. Several well marked and beautifully defined irregularities in the belts showed the rotation most clearly even in half an hour's watching, Jan. 23, 8h. 15m. Satellite I. just entered on disc of Jupiter and appears as an intensely white spot. 9h. 20m., shadow of I. on centre of disc, black and sharply circular, the satellite itself cannot be seen." Mr. T. W. Backhouse, of Sunderland, observed the transit of satellite I. on Jan. 14. At 13h. 54m. it "appeared as a faint white spot." On Feb. 3, 6h. 7m., he examined satellite III., and its shadow when in transit. The satellite itself was, at the time mentioned, nearly half across Jupiter on a darkish belt. "It is much darker than the darkest part of the planet." At 7h. 30m., it was "still very plain, but only the same shade as the darkest part of Jupiter. It was smaller than its shadow which was very black."

T. Coronæ Borealis.—Mr. T. W. Backhouse says:—"A change has taken place in this star. On its fading for the second time it became stationary in brightness about the middle of the year 1867, since which time, up to the beginning of this year, it continued the same, but with frequent slight fluctuations, which, however, ceased so far as I could judge, at the end of 1869. I have suspected fluctuations since 1869, but they were doubtful. On Jan. 14, this year, I looked at the star and found it about its usual brightness, or, perhaps, a little fainter, but certainly not fainter than it had been at times previously. I did not look at it again till March 5, when I found it much fainter than I ever saw it before, perhaps half a magnitude less than usual, and it was the same on the following day."

Nebula in the Pleiades.—Mr. H. W. Hollis has looked for this nebula with his 8-in. achromatic, but cannot find it. He says, "There is something peculiar about all the brighter stars of this group, which, for months past, have appeared to me as if surrounded with nebulous lights. Can the nebula have been distributed amongst them ?"

Meteors.—The Rev. S. J. Johnson, of Crediton, witnessed the appearance of "a splendid meteor at 7h. 37m., April 6. Its course was in a straight line downwards from about 15° above the N.W. horizon, to about 5°. Colour white with a greenish tinge. Duration about 5 seconds. Seen against a dark sky, this meteor would have equalled, if not exceeded, the brightness of Venus or Jupiter. I was looking for Mercury at the time." On April 19, 11h. 10m., Mr. William F. Denning, of Bristol, saw a brilliant meteor. It passed slowly down the N.N.E. sky. It was star-like in appearance and left no train of light.

Mercury.—The Rev. S. J. Johnson observed Mercury both with the naked eye and telescope, on the evenings of March 25 and April 5. A power of 100 on a small telescope brought out the phase.